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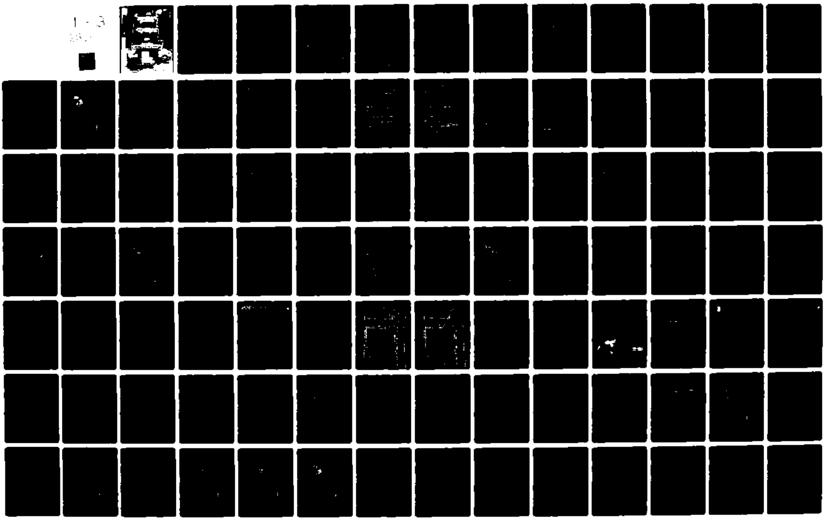

DRAFT

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

PROPOSED PLAN FOR THE CRESCENT CITY HARBOR PROJECT,

DEL NORTE COUNTY, CALIFORNIA

The responsible lead agency is the U.S. Army Engineer District, San Francisco. The responsible cooperating agency is the U.S. Fish and Wildlife Service, Sacramento.

ABSTRACT

This project, described in House Document No. 264, was authorized by the 89th Congress in the River and Harbor Act of 1965. The inner harbor basin as authorized, would have a project depth of 20 feet below MLLW, a 300-foot wide entrance, and would extend along the northeast side of the inner breakwater and along the northwest side of Citizen's Dock. The inner breakwater extension, authorized in the same legislation was completed in 1973. The navigation improvements were authorized to facilitate and reduce delays in receipt of petroleum products at Crescent City Harbor. A final environmental statement on the entire project was filed with the Council on Environmental Quality in 1972. Recent navigation problems in the harbor entrance as a result of shoaling, and other changes in the project area since 1965 have lead to a reevaluation of the recommended deepening plan. The purpose of this supplement is to describe the proposed changes in the authorized plan and to present the results of additional studies conducted.

Various plans for the offloading of petroleum products were analyzed. Those studied in detail include the No Action Plan (Plan A), the modified authorized plan (Plan B), and a relocation of the oil dock to the inner breakwater extension (Plan C). Both Plans B and C contain the dredging of a harbor entrance channel to a depth of 20 feet below MLLW. The key environmental components in evaluating these plans are: (1) water quality, (2) benthos, (3) spawning habitat, (4) marine organisms at the proposed ocean disposal site, (5) endangered or threatened species, (6) commercial and sport fisheries, (7) marine mammals, and (8) intertidal flats, energy, local government finance and navigational safety. The plans were also evaluated on their economics and their contributions to the planning objectives of improving navigation safety and efficiency in the harbor.

SEND YOUR COMMENTS TO THE DISTRICT ENGINEER BY: 30 October 1981

If you would like further information on this statements, please contact:

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SUMMARY

Major Conclusions and Findings

a. NED Plan. Plan B, the modified authorized plan, has been designated as the NED Plan since it provides more net benefits than any other detailed plan.

b. EQ Plan. Since neither of the detailed action plans made a positive net contribution to the components in the EQ Account, an EQ Plan could not be designated. Both of the action plans require dredging in the inner harbor and entrance channel. The adverse environmental impacts are short-term and temporary and occur only during the construction and maintenance periods. Initial construction for Plan B would require 58 days, with 10 days biannually over the life of the project (50 years) for maintenance, and about 20 days of dock repair. Plan C would require 45 days of construction dredging, 9 days biannually for maintenance, and about 58 days to rebuild the dock. These plans would be equally environmentally damaging since the construction and maintenance periods would extend for 328 days over the 50 year project life with the implementation of either plan.

c. Recommended Plan. Plan B is the recommended plan since it would provide major contributions to the NED account and satisfies both planning objectives. It is also the only plan within the funding capabilities of the local sponsor.

Areas of Controversy. There are no areas of controversy.

Unresolved Issues. All conflicts have been resolved.

Relationship to Environmental Protection Statutes and Other Environmental Requirements. The objectives and requirements of environmental laws, executive orders, Federal, State, and local land use plans and policies that apply to the study area are discussed in the following paragraphs. Noncompliance of the detailed plans with these requirements are discussed as are attempts to resolve these inconsistencies. Table 1 is a summary of the detailed plans and their compliance with laws, policies and plans.

TABLE 1

RELATIONSHIP OF PLANS TO ENVIRONMENTAL REQUIREMENTS 1/

	Plan B	Plan C
Federal Policies		
Clean Air Act	Both Plans in Full Compliance	
National Environmental Policy Act	Both Plans in Partial Compliance - Draft Supplemental Stage	
Clean Water Act	Both Plans in Full Compliance	
Marine Protection, Research & Sanctuaries Act	Both Plans in Full Compliance	
Fish & Wildlife Coordination Act	Both Plans in Full Compliance	
Endangered Species Act	Both Plans in Full Compliance	
Executive Order 11990, Protection of Wetlands	Both Plans in Full Compliance	
Chief of Engineers Wetland Policy	Both Plans in Full Compliance	
Water Resources Development Act	Both Plans in Full Compliance	
National Historic Preservation Act	Both Plans in Full Compliance	
Executive Order 11593, Preservation	Both Plans in Full Compliance	
& Enhancement of Cultural Resources	Both Plans in Full Compliance	
	Comments requested on this EIS supplement	
Estuary Protection Act	Both Plans in Full Compliance	
Coastal Zone Management Act	Both Plans in Full Compliance	
State & Local Policies		
State Water Resources Control Board, Water Quality Control Plan for Ocean Waters	Both Plans in Full Compliance - State has waivered certification	
State of California Wetland Policy	Both Plans in Full Compliance	
California Coastal Act	Both Plans in Full Compliance	
Land Use Plans		
Del Norte County General Plan	Both Plans in Full Compliance	
Draft Crescent City Harbor Portland Use Plan	Both Plans in Full Compliance	

1/ The compliance categories used in this table were assigned based on the following definitions:
(a) Full Compliance - All requirements of the policy and related regulations have been met.
(b) Partial Compliance - Some requirements of the policy and regulations remain to be met.
(c) Non-Compliance - None of the requirements of the policy and related regulations have been met.

a. Clean Air Act (PL 91-604; 84 Stat. 1704; 42 USC 1857 et seq).

The objective of the Clean Air Act is to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the production capacity of its population. Under this Act the Administrator of the Environmental Protection Agency has established a set of Ambient Air Quality Standards but the primary responsibility for the prevention and control of air pollution is left to the States and local agencies. The California North Coast Air Basin Air Pollution Coordinating Council has prepared the Air Pollution Control Plan for the California North Coast Air Basin. New air monitoring statistics and revised emission inventories have confirmed that vehicle emissions and photochemical air pollutants are not a serious problem in the North Coast Air Basin. Monitoring data indicate air quality to be well within State and Federal standards for carbon monoxide, nitrogen dioxide and oxidents. Industrial emissions of sulfide oxides result in ambient air concentrations far below all applicable standards. Particulate matter is the major air pollutant in the North Coast Air Basin and remains as the focal point of present and future control program efforts (California North Coast Air Basin Air Pollution Coordination Council, 1975). It has been determined that emissions would not be increased by implementation of the proposed navigation improvements based on a projected decrease in the number of vessels servicing the area.

b. National Environmental Policy Act (NEPA) (PL 91-190; 83 Stat. 852; 42 USC 4321 et seq.) NEPA establishes a national environmental policy to insure that Federal actions do not contribute to environmental problems. Federal agencies are required to comply with procedures as established by the Act and published as Federal regulations. NEPA directs all Federal agencies to include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed environmental impact statement. This supplemental environmental impact statement will, when it is filed in final form, fulfill the requirements of NEPA.

c. Clean Water Act, Section 404 (PL 95-217; 91 Stat. 1600; 33 USC 1344 et seq.) The objective of the Clean Water Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. Section 404(b) of the Clean Water Act, as amended in 1977, requires that the Corps evaluate the impacts of the discharge of dredged or fill material into waters of the United States in order to make specified determinations and findings. A public notice was issued on 25 January 1980 which described the results of the technical evaluation of the discharge of the proposed dredged material into open waters of the U.S. Based on these results, it was determined that ocean dumping would not have a potential for adverse effect on wetlands or on the marine environment or ecosystem (Appendix A). The California Regional Water Quality Control Board - North Coast Region concurred with these findings and recommended to the State Water Resources Control Board that certification be waived. No material to be dredged will be sold for commercial purposes in accordance with statutes of 1963, Chapter 1510, State Lands Commission. No permit from the State lands Commission is required for this project.

d. Marine Protection, Research and Sanctuaries Act (MPRSA) Section 103 (PL 92-532; 86 Stat. 1052; 33 USC 1404 et seq). Provisions of MPRSA require that the Secretary of the Army make determinations for the transportation of dredged material for the purpose of dumping it into ocean waters, which conclude that there will be no unreasonable degradation or endangerment to human health, welfare, or amenities of the marine environment, ecological system, or economic potentialities. Bioassay procedures were used to evaluate potential impacts on the marine environment. These procedures are also applicable to regulations which implement Section 404 of the CWA and are discussed in Appendix B. The proposed dredged material from Crescent City inner harbor and entrance channel were deemed environmentally acceptable for ocean dumping based on the results of the Section 103 evaluation.

e. Fish and Wildlife Coordination Act (FWCA) (PL 85-624; 72 Stat. 563; 16 USC 661 et seq). The FWCA requires that whenever any channel is proposed or authorized to be deepened, Federal agencies responsible for such action must first consult with the U.S. Fish and Wildlife Service (FWS) and State agencies exercising administration over wildlife resources. Federal agencies must make the reports and recommendations of the FWS and State agency an integral part of the reports for engineering surveys when submitted to Congress for authorization of construction. The project plan shall include such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits. The Draft FWS Coordination Act Report was provided in December 1980. No compensation has been suggested by the FWS for implementation of either plan. Specific recommendations by FWS are found in Appendix C.

f. Endangered Species Act (PL 93-205, 87 Stat. 884; 16 USC 1531 et seq), Section 7. Section 7(a) of the Act requires, among other things, that Federal agencies, in consultation with and with the assistance of the Secretary of the Interior, insure that their actions do not jeopardize the continued existence of endangered or threatened species or destroy or adversely modify the critical habitat that supports such species. Review of the U.S. Fish and Wildlife Service Listing and the State of California endangered species publications in relation to the detailed plans indicates no effect upon rare, endangered, or threatened species or critical habitat in the project area.

g. Executive Order 11990, Protection of Wetlands. Federal agencies are directed to provide leadership, to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands, in carrying out the agency's responsibilities. This policy states that Federal agencies should avoid to the extent possible the long- and short-term adverse impacts associated with destruction or modification of wetlands. The agency shall also avoid undertaking and providing support for new construction including draining, dredging, channelizing, filling, diking, impounding and related activities located in wetlands, unless the agency head finds: (1) no practicable alternative and (2) all practical measures have been taken to minimize harm to wetlands. In making this finding, the agency head may take into account economic, environmental and other pertinent factors. Implementation of any of the detailed plans would have no adverse impact on wetlands.

h. Chief of Engineers Wetland Policy. This policy declares wetland to be vital areas constituting productive and valuable public resources. Alteration or destruction of wetlands is discouraged as contrary to the public interest. Wetland functions considered important to the public interest are delineated in the 19 July 1977 Federal Register. Federal projects affecting a particular wetland site will be evaluated with respect to the complete and interrelated wetland area. No construction activity will occur in wetlands delineated as important to the public interest, unless the District Engineer (DE) concludes the benefits of the alteration outweigh the damage to the wetlands and the alteration is necessary to realize the benefits. The DE must demonstrate the need to locate the project in the wetland and must evaluate the availability of feasible alternative sites. Implementation of either of these detailed plans would have no adverse impact on wetlands.

i. Water Resources Development Act (PL 94-587; 87 Stat. 884; 16 USC 1531 et seq), Section 150 (WRDA). This legislation furnishes the Chief of Engineers with authority to plan and establish wetland areas in connection with dredging required for water resources development projects based on the following findings:

1. The benefits of the wetland area justify the cost above that required for alternative methods of disposal.
2. The increased cost of wetland development does not exceed $400,000.
3. Reasonable evidence exists that the wetland area will not be substantially altered or destroyed by natural or man-made causes.

The establishment of wetlands as provided in this Act was not determined feasible for the recommended plan. The conditions of potential fill areas in the vicinity of the recommended plan would not permit the establishment of wetland areas without changing existing intertidal flats or shallow water areas.

j. National Historic Preservation Act (NHPA) (PL 80-665; 80 Stat. 915; 16 USC 470 et seq). The NHPA requires that Federal agencies take into account the effect of their undertakings upon National Register properties. The National Register listing of Historic Places has been consulted and no National Register property would be impacted by the proposed plan. See Appendix D for further discussion.

k. Executive Order 11593, Preservation and Enhancement of Cultural Resources. This executive order directs Federal agencies to assume leadership in preserving and enhancing the Nation's cultural heritage to survey and nominate to the National Register historic properties under their jurisdiction, to refrain from impairing historic properties under their control and to initiate measures to ensure that their programs and policies contribute to the preservation and enhancement of non-Federally owned historic resources. The State Historic Preservation Officer has been contacted informallly and it has been determined that no State Historic Landmarks or State Points of Interest exist within the study area.

l. Estuary Protection Act (PL 90-454; 82 Stat. 625), Section 4. In this Act, Congress recognizes, preserves and protects the responsibilities of the States in protecting, conserving and restoring the estuaries in the United States. The Act also directs all Federal agencies to give consideration to estuaries and their natural resources and their importance for commercial and industrial developments, and to include in all project plans and reports affecting such estuaries and resources submitted to Congress, a discussion by the Secretary of the Interior of such estuaries and such resources and the effects of the project upon them and his recommendations thereon. The Secretary of the Interior shall make his recommendations within ninety days after receipt of such plans and receipt of such plans and reports. These recommendations would be described in the Fish and Wildlife Coordination Act Report (see Fish and Wildlife Coordination Act above).

m. State Water Resources Control Board, Water Quality Control Plan for Ocean Waters of California, 1978. The purpose of this policy is to protect the quality of ocean waters for use and enjoyment by the people of the State. It requires control of the discharge of waste to ocean water. This plan is applicable to point and nonpoint source discharges but does not control dredging. The plan sets forth limits or levels of water quality characteristics for ocean waters, ensures the reasonable protection of beneficial uses and the prevention of nuisance, and provides that the ocean discharge will maintain the indigenous marine life and a healthy and diverse marine community, and sets forth discharge prohibitions. It has been determined that the discharge of the proposed dredged material into the ocean would meet the criteria set forth in this plan.

n. State of California Wetland Policy. This policy recognizes the value of marshlands and other wetlands. Basically, the Resources Agency and its various departments will not authorize or approve projects that fill or otherwise harm or destroy coastal, estuarine, or inland wetlands. Exception may be granted if all the following conditions are met:

1. The project is water dependent.
2. No feasible, less environmentally damaging alternative is available.
3. The public trust is not adversely affected.
4. Adequate compensation is part of the project.

None of the detailed plans would impact any wetlands.

o. Coastal Zone Management Act (PL 92-583) and Amendments of 1976 (PL 94-370) (CZMA). This Act establishes national policy to preserve, protect, develop and where possible restore or enhance the resources of the Nation's Coastal Zone. It directs all Federal agencies engaged in programs affecting the coastal zones to cooperate and participate with State and local governments and regional agencies in implementing the purposes of this Act. In accordance with this Act, as amended, Section 307(c)(1), the Corps has determined that the proposed dredging and ocean disposal of dredged material from Crescent City inner harbor and entrance channel would be consistent with the California Coastal Act to the maximum extent practicable.

p. California Coastal Act of 1976 (SB. 1277; California PRC 30000 et seq). This Act provides for the protection of the States's natural and scenic resources and prevention of the deterioration and destruction of the coastal zone, and sets forth the basis goals of the State for the coastal zone. The proposed project has been determined to be consistent with the applicable sections of the Act to the maximum extent practicable for the following reasons:

Chapter 3, Article 4, Marine Environmental Sections 30230 and 30231. These sections state that marine resources, biological productivity, and quality of coastal waters shall be maintained, enhanced or restored. Marine resources, biological productivity and water quality would not be significantly adversely impacted by the ocean disposal of dredged material. The material to be ocean dumped meets the EPA criteria for Ocean Dumping as described in 40 CFR 220-229. An evaluation of the discharge of dredged material is found in Appendix B.

It is our determination that the proposed disposal would not unduly degrade or endanger the marine environment and that the disposal would present:

1. No unacceptable adverse effects on human health and no significant damage to the resources of the marine environment.
2. No unacceptable adverse impact on the marine ecosystem.
3. No unacceptable adverse persistent permanent effects due to dumping of the particular volume or concentration of these materials.
4. No unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

Section 30233: This section permits the diking, filling, or dredging of open coastal waters, wetlands, estuaries, and lakes where (a) There is no feasible, less environmentally damaging alternative to the proposed dredging. Mitigation measures would be provided to compensate for and minimize adverse environmental effects. Dredging is limited to expansion of an existing port which satisfies the criteria in (a)(1). (b) Dredging and disposal would be carried out to avoid significant disruption to marine and wildlife habitats and water circulation. Every reasonable effort would be made to cease dredging operations between November and June. (c) Dredging would not impair the functional capacity of the wetland or estuary.

Del Norte County General Plan. Under this plan, Crescent City Harbor is planned for continued development as a commercial harbor. This plan also seeks to develop harbor access and to increase the harbor's economic viability. The proposed deepening would therefore be consistent with this plan.

Crescent City Harbor Port Land Use Plan (DRAFT 1980). This document stresses the need for the continuing development and expansion of the harbor to satisfy all commercial, recreational, and public demands. The proposed project is consistent with this plan.

NEED FOR AND OBJECTIVES OF ACTION

Study Authority and History. The Crescent City Harbor Project was authorized by the River and Harbor Act of 1965. The authorization consists of an extension to the existing inner breakwater and a 20-foot deep T-shaped basin. These navigation improvements were authorized to facilitate and reduce delays in receipt of petroleum products.

In 1971, a General Design Memorandum (GDM) was prepared. A Final Environmental Statement on the project was filed with the Council on Environmental Quality in 1972. Construction of the breakwater extension was completed in 1973. Modification of the recommended dredging plan has required additional studies and evaluation. The purpose of this Supplemental Environmental Statement is to describe the changes in the recommended plan and the results of the additional studies.

Public Concerns. Navigation safety and efficient transport of petroleum products are public concerns expressed by the local residents of Crescent City at a Public Hearing held in February 1980. They noted that they were experiencing tidal delays, vessel damage, and numerous groundings due to the continued shoaling of the harbor. The tug and barge operators stated that they were using inefficient combinations and only partially loaded barges in order to bring petroleum products into Crescent City Harbor.

Conservation and protection of the harbor and offshore ocean environment as a habitat for fish, wildlife, and marine mammals was identified as a public concern at the scoping meeting, public workshop, and in letters from the U.S. Fish and Wildlife Service and the National marine Fisheries Service (see Appendix C). These concerns have been expressed in several Acts, including the Endangered Species Act of 1973, the Marine Mammal Protection Act of 1972, and the Marine Protection, Research and Sanctuaries Act of 1972.

Concern has been expressed for the protection of commercial and recreational fishing opportunties which the Crescent City area provides. Over 50 percent of the full-time equivalent jobs in Crescent City are related to the fishing industry or its support facilities and services.

Protection of wetlands in an around the harbor area has been identified as a concern which has been expressed in the President's Executive Order 11990.

Planning Objectives. The planning objectives are the water and related land resource management needs specific to the study area. Public concerns and other issues identified in this study were analyzed to determine whether they can be directly related to problems that can be addressed through water and land resources management actions within the scope of this study. The public concerns related to the efficiency of petroleum barge traffic and navigation safety can be addressed as planning objectives. The following planning objectives were used in the plan reevaluation:

a. Provide for more efficient barge shipment of petroleum products into Crescent City Inner Harbor from the present to the year 2032.

b. Improve the saftey margin for navigation of vessel traffic using Crescent Harbor from the present to the year 2032.

ALTERNATIVES

The formulation of alternatives or plans involves the identification of plan elements which address one or more of the planning objectives. These elements are reviewed for economic and engineering feasibility as well as environmental acceptability. The plan elements evaluated in this study include:

1. Excavation of The Existing Navigation Channel and Entrance Channel to Authorized Project Depth (-20 feet, MLLW). Initial dredging would remove approximately 138,000 cubic yards (c.y.) of sediment (sandy silt) and rock from the navigation channel, and 18,000 c.y. of fine sand from the entrance channel. Annual maintenance dredging would remove an additional 50,000 c.y.

2. Relocation of Offloading Facilities Within The Harbor. The oil terminal facilities could be relocated to either the outer harbor or along the inner breakwater extension. Both locations would require excavation of sediments to authorized project depth. Re-establishment of the outer harbor basin to the authorized project depth and annual maintenance would also be required. The area along the inner breakwater extension would require the removal of 84,000 c.y. of dredged material during initial construction, and 18,000 c.y. annually. Both elements would require dredging 18,000 c.y. of sand from the entrance channel.

3. Offshore Unloading Facilities. This element would provide sufficient maneuvering area and depth offshore for the unloading of petroleum products. It would also reduce the congestion in the harbor. Four offshore systems in regular use are conventional mooring buoys, single point mooring buoys (monobuoys), the sea island and marginal pier. Conventional mooring buoys maintain the vessel in a fixed position and orientation. Their use is limited to sites where the prevailing wind is longitudinal to the berth, or at least where strong winds are not expected broadside to the berth. Petroleum products are pumped ashore via a flexible hose and submarine pipeline. Sea islands and marginal piers are fixed structures which also maintain the vessel in a fixed position while unloading. Fixed structures are not well suited to sites where severe wave and wind conditions can be expected. A single point mooring buoy consists of a fixed vertical axis cylindrical buoy with a swivel top to which the product delivery hoses and mooring lines are attached. The vessel is thus free to swing around the buoy and position itself into the prevailing winds and currents as the product is being unloaded. The product is pumped ashore via flexible hoses and submerged pipelines.

4. Groins/Breakwaters/Sand Barriers. Construction of structural measures such as groins, breakwaters, or sand barriers would be built to trap or block the inflow of sediment into the harbor and reduce further shoaling.

These elements would optimally prevent future buildup of harbor sediments but would not improve the existing inadequate depths. These elements would either reduce or eliminate any maintenance costs.

5. Disposal of Dredged Material. The Final EIS described three alternative sites for the disposal of dredged material. The beach site south of the sand barrier is not acceptable for disposal of silts, clays, and organics from the inner harbor under Section 103 of the Marine Protection Research and Sanctuaries Act (MPRSA) of 1972 due to the incompatibility of the dredged sediment with the beach sands. Razor clam beds near the beach site would be buried if dredged material were placed there. The second site was an open water one in the Battery Point area outside the outer (North) breakwater. Use of this site is no longer feasible under the criteria and regulations published by EPA for Ocean Dumping (40 CFR 220-229). The remaining site was the vacant land between Citizen's Dock and the mouth of Elk Creek. Most of this area is now occupied by a 308 berth small boat basin and a trailer park (see Figure 1). The remaining land is owned by the Harbor District and is used for their annual maintenance dredging of about 10,000 c.y. of sediment. The harbor also has plans to develop the area into a 150 berth marina and its associated facilities and services (Winzler and Kelly, 1980).

Since there are no land sites available and the material is unsuitable for beach nourishment, ocean disposal is the only remaining alternative for dredged material disposal. EPA has interimly designated a 1,000 yard diameter ocean disposal site at 41°43'15"N., 124°12'10"W (see Appendix E).

Plans Eliminated From Further Study. Some of the plan elements were eliminated from detailed study:

1. Offshore Unloading Facilities. The most likely location for an offshore facility is south of the sand barrier and due west of the tank farm in about 30 feet of water. The most feasible type of offloading facility is the monobuoy due to the severe weather conditions experienced at Crescent City. The monobuoy is the most flexible system and may be designed for head waves of 15-20 feet in combination with high winds and waves. In a 1973 study, a Crescent City site for unloading crude oil using large tankers was eliminated from further consideration because it was determined that "protective breakwaters would be required for the monobuoys as a result of the severe weather conditions" (CE, 1973). This constraint is even more applicable to barge-tug operations than it is to large tanker operations. A system including breakwaters is not economically justified. It is also environmentally unacceptable due to the extensive kelp and razor clam beds in the area which would be adversely impacted by the construction or by an oil spill.

2. Relocation of the Oil Dock to the Outer Harbor Basin. Excessive dredging, construction of a new oil dock, relocation of pipeline from the new oil dock to the existing tank farm as South Beach make this element economically unjustified and environmentally unacceptable. The outer harbor is subject to severe southeast winds known as kickback or back draft, which blow with considerable violence. This would make unloading hazardous and would increase the probability of an oil spill.

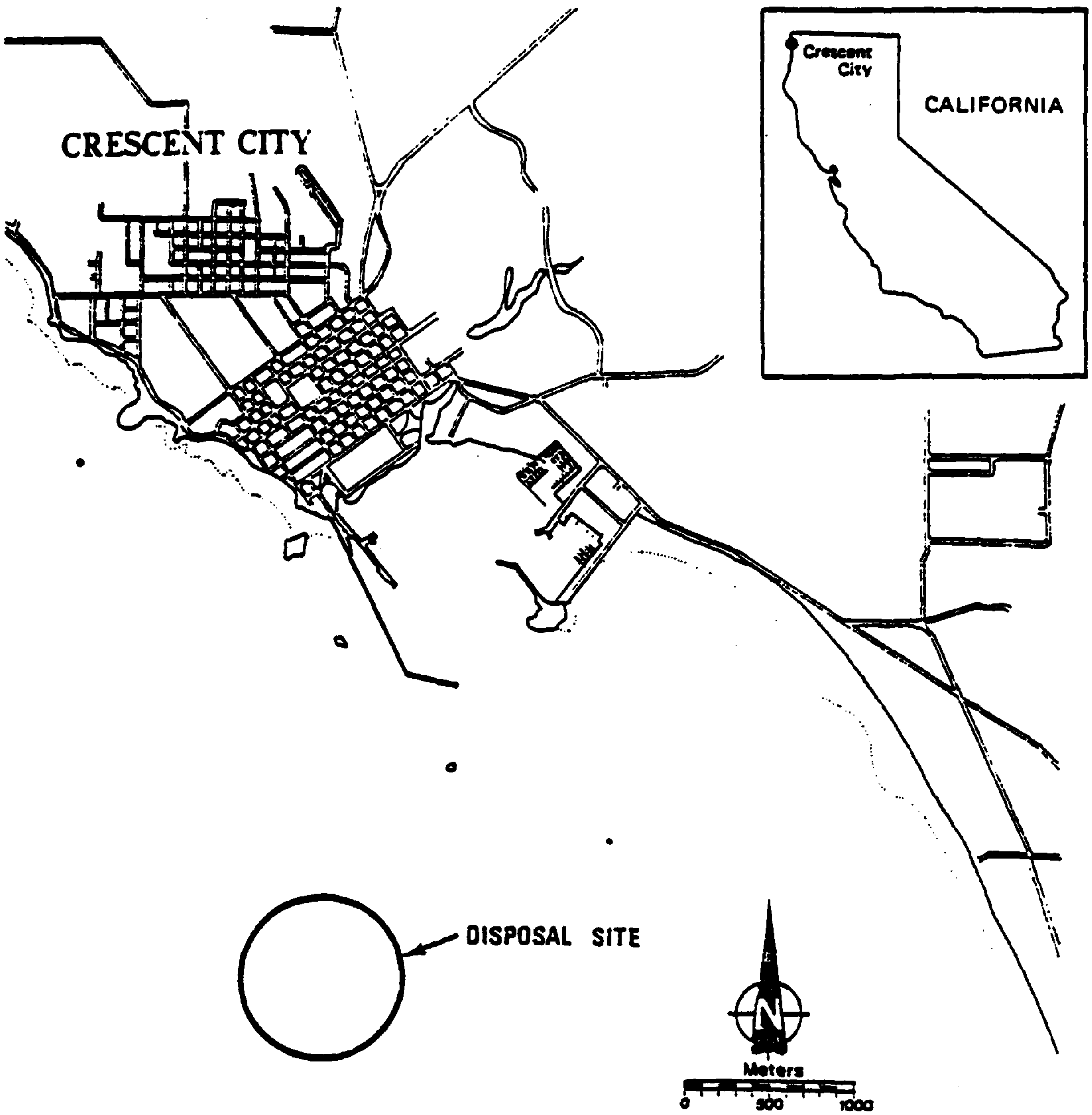


Figure 1. Proposed disposal site location near Crescent City Harbor, California.

3. Groins/Breakwaters/Sand Barriers. Before such measures could be implemented detailed studies, including model testing, would have to be conducted to determine the optimum alignment. To prevent any material from entering the harbor, the alignment of existing structures may need modification. To satisfy either of the planning objectives, this measure would have to be combined with dredging and disposal elements. Because of the great uncertainty of producing the desired result, this alternative was eliminated from further consideration.

4. Beach and land disposal sites for dredged material have been eliminated from further consideration due to unsuitability and unavailability.

No Action or Plan A. Navigation hazards in the entrance channel and inner harbor would continue due to shoaling. Inadequate depths would restrict vessel use and barges would be required to partially offload petroleum products in either Coos Bay or Humboldt Bay before entering Crescent City Harbor. The Harbor District would continue their annual maintenance dredging of 10,000 c.y. per year. The biotic environment in the study area would maintain its present integrity.

Plans Considered in Detail. The plan elements not previously eliminated have been combined into two alternatives for detailed study. The Modified Authorized Plan or Plan B requires excavation of the navigation channel adjacent to the oil dock and the entrance channel to -20 feet, MLLW with ocean disposal of the dredged material. This alternative is the recommended plan and the NED plan. Plan B would satisfy both planning objectives. Implementation of this plan by the Corps of Engineers would be possible. The oil company would be responsible for dredging a 50-foot wide strip adjacent to their dock. There would be no mitigation or compensation required for inclusion in this alternative.

Plan C consists of excavation of the entrance channel and a channel along the breakwater extension and the relocation of the oil dock. This plan would require less dredging than Plan B, would satisfy both planning objectives, and would be implemented by the Corps of Engineers. The local sponsor would provide the cost for the relocation of the oil dock.

None of the alternatives investigated provided a net positive contribution to the EQ account.

AFFECTED ENVIRONMENT

This section defines the study area and describes the environmental conditions and significant resources in the study area.

Study Area. This term is used to define a geographic space with an identified boundary that includes the locations of the detailed alternative plans, and the locations of resources that would be directly, indirectly, or

cumulatively affected by alternative plans. The study area is Crescent City Inner Harbor, the entrance channel and the proposed ocean disposal located at 41°43'15"N, 124°12'10"W (Figure 1).

Environmental Conditions. Crescent City is located in Del Norte County on the California coast about 283 miles north of San Francisco and 17 miels south of the Oregon border (Figure 1). Del Norte County's permanent population was 15,400 in 1975 with 80 percent of the people residing in Crescent City. Geologically Crescent City and its harbor are located on the south edge of a broad marine tererace bordered on the south and west of the Pacific Ocean, with steeply rising densely forested mountains on the north and east. The Del Norte Coast including Crescent City, experiences moderate temperatures averaging 46°F in January, and 58°F in August. The average precipitation is 70 inches per year. Severe storms, winds and squalls occur frequently along the coast, particularly during the winter season. Heavy fog occur in this area during the summer months.

Crescent City Harbor is a small (about 450 acres) commercial harbor which consists of a 308-berth small boat basin, a 527-slip mooring facility, fish processing plants and docks, an oil terminal, a small boat repair facility, a Coast Guard pier, and other auxillary commercial or recreational facilities. Petroleum products now comprise over 90 percent of the total commerce in the harbor. Petroleum products are piped to an eight million gallon tank farm located about one miles from the harbor. Currently, about 72 million gallons of petroleum products per year pass through the tank farm, and are distributed throughout Del Norte County.

The harbor's naturally crescent-shaped beach is bounded by a 4,700-foot long rubblemound outer breakwater to the west, a 2,400-foot long sand barrier to the east, and a 1,600-foot long rubblemound inner breakwater to the south. The present entrance to the harbor open on the southerly side and is approximately 2,000 feet long. At its entrance, the harbor has depths of 25-28 feet below MLLW. These depths gradually decrease to about 19 feet MLLW at the end of the inner breakwater and then slopes uniformly to the sand beaches at the east side of the harbor.

The most prominent feature of the harbor is Whaler Island, which rises 70 feet above MLLW. This feature no longer exists as an island as it is joined to the sand barrier and inner breakwater. The harbor bottom is an irregular rock surface with numerous pinnacles projecting above the water surface. One of the largest pinnacles in the harbor is Pelican Rock which is located in the Inner harbor and which is used extensively by the California brown pelican as a roost.

The only surface drainage entering the harbor is Elk Creek, located at the extreme north end. Its watershed covers approximately 4.8 square miles (3,091 acres) and is composed of predominantly low-density sururban development and pasture lands. Elk Creek, a small intermittent stream, historically supported small spawning runs of steelhead trout, silver salmon, and cutthroat trout. However, past lumber practices have significantly reduced these runs.

Significant Resources. These are resources that are located in or near the study area and which may be affected by one or more alternative plans. The description of their existing condition is the baseline which is used to identify potential planning constraints and to provide a basis for impact assessment. Significant resources that are institutionally, publically, or technically recognized as important to people will be considered in the evaluation of alternative plans.

Water Quality. This component is presented as a significant resource based on the concerns of the Clean Water Act of 1977 and the Marine Protection, Research and Sanctuaries Act of 1972. The nature of sediment-water interactions, as affected by the type and mode of disturbance or resuspension, the particle type and water content, dictates the changes occurring in water quality conditions. Sediment-water interactions imply both chemical reactions and sediment loading of the water column.

The effects of dredging on water quality are considerably less severe than those of the disposal operation. Water quality indicators of concern include: pH, salinity, temperature, concentrations of dissolved oxygen, suspended solids, heavy metals, petroleum hydrocarbons, and pesticides.

There appears to be no chemical contamination of the dredge or disposal site waters. Water samples were collected from the dredge site in January 1979, from the disposal site in January, June, and November 1979, and from an offshore reference site in January 1979 and were analyzed for heavy metals, petroleum hydrocarbons, and pesticides (Appendix A, Tables 4 and 6; Appendix E, Table 12). There were no detectable levels of zinc, lead, petroleum hydrocarbons, and pesticides (other than organohalogens) in any of the January 1979 water samples tested. Concentrations of mercury, cadmium, copper, oil and grease, and persistent organohalogens were measurable in these samples, but were well below the criteria established by the State Water Resources Control Board (SWRCB) in their Water Quality Control Plan for Ocean Waters of California (Appendix A, Table 6).

Samples collected in November 1979 at the disposal site showed no detectable levels of oil and grease, PCB's and total ildentifiable chlorinated hydrocarbons. Zinc and lead were present but at levels below the SWQCB's criteria. Phenols exceeded the State Criteria at three bottom stations at the disposal site.

Potential contaminant releases due to disposal operations will be evaluated using a laboratory chemical test which somewhat simulates dredging and disposal conditions. The results of this elutriate test (40 CFR 220, 1977), will be compared to background levels of contaminants measured in the water at the disposal site.

The water quality in the harbor appears to be improving with respect to measurable levels of oil and grease. High levels of organically derived oil and grease were present in 1975 elutriates of dredged material from the Outer Harbor. These natural oils were believed to come from wood chips which were a by-product of the lumber industry. Water and elutriate samples analyzed in

1979 from the study area showed concentrations of oil and grease at the detection limit. This decrease in oil and grease may be correlated to the decline in the lumber industry in Del Norte County. Since 1971, no lumber has been exported from Crescent City Harbor.

Measurements of conductivity, concentrations of dissolved oxygen, and turbidity were taken at the disposal site in June and November 1979. The water column at the center of the disposal site was highly stratified in June 1979. A sharp thermocline was found between 8 and 12m and 10m (Appendix E, Tables 2 and 3). The water column was less stratified in November, and there was no evidence of a thermocline (EA, 1980). The temperature, conductiviry, dissolved oxygen and pH were all influenced by the summer stratification (EA, 1980). Surface temperatures average 12.3°C and bottom temperature average 7.8°C. Conductivity increased with increasing depth, but varied little below the thermocline. Average dissolved oxygen levels were 10.0 ppm at the surface, increased to a maximum near the thermocline (10.4), and then dropped to low levels toward the bottom (2.6). The pH levels aveage 8.3 above the thermocline and decreased to an average of 7.4 near the bottom. Turbidity was at a minimum between 13 and 19m (0.7 NTU) and appeared to be unaffected by the summer stratification. The lack of stratification in the fall survey resulted in a nearly homogeneous water column. The average water temperature was 13.5°C and the maximum difference between surface and bottom reading was 1.2°C. Dissolved oxygen levels averaged 9.5 ppm and were uniformly high throughout the water column. The pH averaged 7.9 and was nearly invariant across all stations and depths. Turbidity levels remained farily constant, averagilng 0.6 NTU. Conductivity was the only water quality parameter that appeared to be somewhat stratified in the fall. Surface values averaged about 46,000 umhos; bottom vlauesaverage approximately 50,000 umhos.

Benthos. This element is considered a significant resource because of its position and importance in the food web. These organisms are filter feeders, deposit feeders, scavengers and algae scrapers. They are used as food by a number of fish species. Benthos also contribute substantially to the total biomass and diversity in the harbor and at the disposal site.

Two types of benthic organisms are found throughout the study area: those that live in the sediments (infauna) and those that live on the sediments (epifauna or epibenthos). The infauna are typically sessile, are found in aggregates or clusters, and are usually distributed according to sediment size.

Approximately 1.5-2.0 feet of organic clayey silts are found in the harbor adjacent to the oil dock. These sediments appear to be anoxic based on the smell of hydrogen sulfide from core samples collected by divers in January 1979. It is believed that relatively few organisms inhabit these sediments. Sediments in the entrance channel appear to be primarily silty sands with few organics. Typical benthic organisms which might inhabit this area include polychaete worms, gastropods, and pelegpods. Basket cockles (Clinocardium nuttallii) have been collected in the harbor near the mouth of Elk Creek.

The disposal site sediments are predominantly fine sands. There are numerous rock pinnacles throughout the disposal area. The disposal site sediments contain a rich diversity and abundance of benthic organisms. More than 5,300 organisms from 127 taxa were collected in the benthic samples at the disposal site in June 1979. In November, an additional 45 taxa were

collected and identified. The most abundant organism collected in both the summer and fall surveys was the polychaete Owenia collaris, followed by the gastropod Olivella pycna and the bivalve Epilucina californica.

The epibenthic organisms tend to be more mobile and less particular about sediment size. Adult Dungeness crabs (Cancer magister) migrate into Crescent City Harbor during the winter to spawn. The larvae settle out of the water column in June and July and utilize the Harbor as a nursery area. Several species of rockfish occupy the mudflats, sand bottoms, and channels as juveniles. Flatfish occur from 10 feet (3m) to abyssal depths, but most live in water of moderate depths. They are found throughout the Harbor, usually over sand/mud bottoms and some occur in rocky areas. As adults, flatfish feed on crabs, shrimp, marine worms, clams, and clam siphons (Clemens and Wilby, 1961).

More than 17,000 epibenthic organisms from 38 taxa were collected at the disposal site in other trawls during the summer survey. The most abundant species collected were the juvenile Dungreness crab, Pacific tomcod (Microgadus proximus), and the night smelt (Spirinchus starsi). Although 11 additional taxa were identified in the November survey, the overall abundance of fish was lower in fall than in summer. The abundance of invertebrates in the fall collection was greater than in the summer, with the decapods Crangon alaskensis elongata and Cancer magister the most abundant.

The indicators of this resource is the bottom area that will be disturbed by alternative plans, measured in acres, percent survival data of appropriate sensitive species in dredged material, and bioaccumulation potential. Percent survival of thespeckled sanddab (Citharichthys stigmaeus) and the juvenile Dungeness crab (Cancer magister) was determined in 96-hour bioassays. These organisms were exposed to various concentrations of the liquid and suspended particulate phases of the dredged material and to natural and artificial seawater. Percent survival of the burrowing polychaete Nephthys caecoides, the filter feeding sea cucumber Eupentacta quinquesemita, and the deposit feeding gastropod Olivella biplicata was measured after 10 days exposure to the dredged material and a clean reference material. Contaminant uptake in the sea cucumber was determined after this exposure.

Fish Spawning Habitat. The rockfish or rock cod family is the most diverse group of marine fishes found in California, with 4 genera and 62 described species (Phillips, 1957). They are common harbor inhabitants and tend to occupy rocky areas and piers as adults. The adults feed on squid, octopi, crabs, shrimp and small fish. Small or medium-sized individuals may be eaten by lingcod or other large predatory fish, and marine mammals such as harbor seals. Greenling and lingcod, close relatives of the rockfish and sculpin groups are frequently seen in the harbor around rocks and kelp. They have been reported from the intertidal zone to depths of 250 feet (76m). They usually spawn in the harbor in the winter to early spring, with some species spawning throughout the year. The eggs are deposited in masses on low-growing algae and protected rocky areas in the subtidal area.

The Pacific herring (Clupea haregulus pallasi) is a conspicuous component of the harbor ecosystem. This species enters the harbor between December and February where it spawns demersal eggs which adhere to the breakwaters and kelp. The California Department of Fish and Game estimated the spawning mass to be approximately 160 tons for the winter of 1977-78. Herring feed primarily on pelagic copepods. They are a major food source for many organisms including coho and chinook salmon, lingcod, marine mammals, larger invertebrates and waterfowl. In addition the eggs are eaten by fish and waterfowl, and the larvae are consumed by plankton feeding fish and invertebrates.

The indicator of this resource shall be the volume of water impacted by the alternative plans, measured in liters.

Marine Organisms at the Disposal Site. This component is presented as a significant resource based on the concerns of the Marine Protection, Research and Sanctuaries Act of 1972.

In addition to the 172 benthic and 49 epibenthic taxa at the disposal site, 106 zooplankton taxa were identified in the two field survey. The copepods Calanus pacificies and Pseudocalanus elegatus were the most abundant species collected during the summer at densities averaging $12/m^3$, respectively. During the fall survey the copepods Acartia tonsa and Calanus pacificers were the most abundant species with densities averaging $0.23/m^3$ and $0.25/m^3$, respectively. Copepods exist in the marine environment in such abundance that, although they are very small, they form the principal food supply of many much larger animals.

This resource was evaluated using a 96-hour bioassay. The percent survival of Calanus pacificers was determined in various concentrations of liquid and suspended particulate phases of the dredged material and natural and artificial seawater.

Endangered or Threatened Species. The U.S. Fish and Wildlife Service has listed several species as endangered and other as proposed or candidates for threatened status that occur in or adjacent to the study area. The endangered species include the California brown pelican (Pelicanus occidentalis californicus), the American pregrine falcon (Falco peregrinus anatum), the Aleutian Canada goose (Branta canadensis leucopareia), the finback whale (Balenoptera pnysalus), the gray whale (Eschrichtius robustus), and the Pacific right whale (Eubalena sieboldi).

The California brown pelican occurs along the Pacific coast from Canada to Mexico. In California, breeding occurs in the fall on the Channel Island; in Mexico, on coastal islands in the Gulf of California and off Baja California. Based on a 1972 survey, the estimted total population of California brown pelicans is 100,000 birds, with 20,000 frequenting the California coast from August through November (California Department of Fish a nd Game, 1978). Approximately 50 pelicans have been sighted in the Crescent City Harbor area between May and November, with the largest concentrations occurring between June and September. From 10 to 15 pelicans have been sighted together roosting on pelican rock.

The peregrine falcon has been seen in open country from the mountains to the coastal areas within its known range. Histortically, the peregrine falcon was distributed throughout much of North America. In a 1970 California census, only 10 birds were recorded. No birds have been sighted in the study area. Several areas have been designated by the Endangered Species Office as critical habitat zones for this species in California. None of these areas are in Del Norte County.

The Aleutian Canada geese migrate through the Crescent City area during the winter. They have been seen roosting on Castle Rock at night and feeding in the pastsures North of the Del Norte County Airport. None have been sighted in or near the study area.

While the majority of large cetaceans (whales and porpoises) is found primarily in California's distant offshore waters, small groups of migrating gray whales are frequently seen within a few hundred meters of the shore. The entire population of gray whales passes Crescent City between December and April in its biannual migration to and from the calving grounds in Mexico. These whales are coastal in nature and frequent bays and harbors during their migration.

The rocky coast snail (Monadenia fidelis pronotis), has been proposed for endangered status by the U.S. Fish and Wildlife Service. It has been found on moist coastal terraces at Point Saint George, north of Crescent City. No information is available on the snails' existence in or near the study area. hurber's reed grass (Calamagrostis sp.) is a candidate for threatened status. Although it is primarily a terrestrial plant, it has been found in freshwater marshes and swamps along the Pacific coast from Alaska south to Mendocino County, California. It has not been reported in or near the study area.

These listed species are the indicators of this resource. Their presence or absence and the designation of critical habitat zones in the study area will be evaluated for all detailed plans.

Commercial and Sport Fisheries. Fishing is big business in Crescent City Harbor and shows good promise as a growth industry. Out of a total of 1015 full-time equivalent employees in Crescent City, 587 jobs are related to commercial fishing. Of these 587 jobs, 395 are fleet operators and 192 are employed onshore in fish receiving, processing, boat repair and construction, restaurants, marine supply and other harbor services. In Cresecent City Harbor there are 290 berths for commercial boats, 18 used for recreational boats and 527 slips in the moorage facility. An economic feasibility study concerned that the demand for commercial berths would double between now and 1995, with a particular need for large vessel berths (Tri-Agency EDA, 1979). Based on landings in the Draft Groundfish Management Plan for the Pacific Northwest, most commercial fish are landed by trawl and the largest effort is expended on sablefish, other rockfish, Dover Sole, and other flatfish (excluding Pacific halibut). Since trawling is not permitted within the 3 mile limit, most commercial fishing takes place well offshore and in deep waters.

Fishing in and around the disposal site is limited to crabbing and sportfishing. In 1975, less than 0.5% of the states Dungeress crab landing was taken from the delineated 100 square mile fish block (number 108) in which the site is located. Sportfishery catches have been reported for May through September with the predominant activity occurring in July in August. Lingcod, jack mackerel, rockfish, cabezon, and kelp greenling are taken by sport fishermen along Chase Ledge and in a nearshore band south of Crescent City. The principal sportfishery is for salmon which primarily occurs in a 44-square mile band off Crescent City. Of coho salmon landed in the State 83% were taken from either Eureka of Crescent City (PFMG, 1978). Based on the feasibility study, it is projected that the demand for recreational berths at Crescent City will increase at a rate similar to the demand for commercial berths (Tri-Agency EDA, 1979).

The harbor supports a small commercial fishery (3 licensed fishermen) for Pacific herring roe in the immediate vicinity of the oil dock. Approximately 12-13 tons of roe are harvested annually which has a final market value of about $100,000 (at 1979 prices). The California Department of Fish and Game regulates this fishery with an annual quota of 30 tons.

There is a winter sportfishery that occurs in and near the harbor. Adult Dungeness crabs which move onshore to molt and spawn are taken by sport fishermen. Several fish species including jack smelt, black rockfish, lingcod and red rockfish provide additional sportfishing opportunities within the harbor.

Unpublished angler surveys conducted by the California Department of Fish and Game showed catches of money face eel, silver salmon, and flounder along the inner breakwater.

Small numbers of razor clams are taken from the beach south of the sand barrier to supply local markets and restaurants. Harvest volumes are insignificant compared with the recreational clam take. According to the California Department of Fish and Game, the beach areas delineated on Figure 3 found on page E2-11 constitute the most popular clamming grounds in the harbor. The major species sought include gaper clams, basket cockles, and littleneck clams. Other species taken include bentnose, razor and horseneck clams. This fishery is limited to about 8 or 9 part-time doggers (CDFG, 1979).

This resource will be evaluated using the number of dredging days.

Marine Mammals. The early history of the Pacific coast of North America was greatly influenced by its marine mammal populations. Exploration of western North America by the Russians in the mid-eighteenth century was a result of their search for the fur of the sea otter and northern fur seal. By the beginning of the twentieth century, the populations of marine fur bearers had been vastly reduced by fur hunters. Whaling activities were also carried on along the California Coast by the start of the nineteenth century. Numerous whale species are rapidly approaching extinction. Passage of the Marine Mammal Protection Act of 1972 halted all commercial whaling and provided protection for a number of fur bearing marine mammals.

The most frequently observed whales off the California coast are the gray whale (Eschrichtius robustus), the finback (Balenoptera physalus) and the humpback (Megaptera novaengliae) whales. With the exception of the gray whale, most migrate far offshore. From November to February the southward migration of the gray whales may be observed daily from vantage points along the California coast or from excursion boats that take groups out to sea. Sighting of whales has become a tourist attraction at San Diego and San Francisco. Numerous organizations have been established (such as Greenpeace and Save the Whales) in California to increase the public's awareness of whales and to promote their protection.

The harbor seal (Phoca vitulina), Stellar's sea lion (Eumetropias jubata), and the California Sea lion (Zalophus californianus) have been sighted in the study area. The harbor seal is an active predator in the Harbor, pursuing and feeding primarily on fish but occasionally taking invertebrates as well.

These resources will be evaluated by qualitative assessment of impacts on the populations and on their condition.

Intertidal Flat. For the purposes of this study, extreme low water (ELW) has been chosen at the lower limit of intertidal flat. In general, ELW corresponds to -3 feet MLLW. The upper end has been defined as +10 feet MLLW. Most flats are bare, with only diatoms or occasional patches of algae. The flats exhibit variable primary production and very high secondary production from detritus consumption. Primary production in these habitats is mainly from benthic diatoms and blue-green algae. These microscopic algae, and the zooplankton which feed upon them, are consumed (along with extensive amounts of detritus) by numerous sediment dwellers. These benthic detritious include benthic worms, amphipods, ghost and mud shrimp, macoma clams and occasional insect larvae. This diverse intertidal flat fauna is the principal food source for a variety of shorebirds, such as sanderlings, dunlin, and sandpiper, and smallfish, especially herring, smelt and juvenile salmon. Flounder, sole, and perch also feed on intertidal flats. Many of these fish are harvested by man, or consumed by fish harvested by man.

The existing harbor intertidal flat consists of approximately 417,000 yd^3. Areal coverage impacted by the detailed plans will be used in the evaluation.

ENVIRONMENTAL EFFECTS

Effects of each detailed plan on the previously described significant resources and on other components are shown in Table 2 following this subsection. This subsection provides a more detailed description of the impacts in the Table. Figure 2 depicts the relationship of effects on significant resources and other components resultilng from the navigation improvements and identifies significant effects. Because the impact

ELEMENTS IN THE ENVIRONMENTAL RELATIONSHIP MATRIX

Hydrography - Submerged topography.

Water Quality - Quality of the water as it pertains to established criteria.

Water Circulation - Movement and mixing of water.

Wave Action - The action of waves.

Sedimentation - Removal and deposition of material by water.

Air Quality - The condition of the air in and adjacent to, the study area in terms of its fitness to support life.

Noise - Sound without value.

Endangered Species - Flora and fauna that has been designated as rare or endangered by State and Federal authorities.

Marine Mammals - Class of higher marine vertebrates, that bear live young, are warm blooded, nurse their young, and have hair over most of their bodies.

Spawning Habitat - Aquatic area of the Crescent City harbor used by fish for reproduction purposes.

Benthos - Bottom-dwelling flora and fauna and associated habitat.

Marine Organisms - Free swimming and sedentary aquatic plants and animals.

Intertidal Flats - The area of tidal influence with the lower limit at -3 feet MLLW.

Natural Resources - Actual and potential forms of wealth existing in nature, including both living and non-living resources.

Aesthetic Quality - Aesthetics refer to the perception of natural and manmade beauty and the judgment involved in deciding what is beautiful.

Cultural Resources - Any building, site, district, structure, object, data or other material significant in history, architecture, science, archaeology or culture.

Navigation Safety - The safety of vessels into or out of the harbor

Boating - Recreational use of boats.

Commercial Shipping - The business of shipping goods by private enterprise.

Commercial Fishing - The business of fishing by private enterprise for profit.

Land Use - Use of the land within the study area.

Public Facilities - The availability and adequacy of facilities and services for the public.

Employment - Any occupation, business, trade or profession.

Energy - Power from the burning of fossil fuels, tapping of geothermal and hydroelectric sources, and other sources.

Local Government - Tax revenues, bonds, property values, public facilities and public services are some of the component parts of the local governement finance.

FIGURE 2

ENVIRONMENTAL RELATIONSHIP MATRIX

PASSIVE ELEMENTS \ ACTIVE ELEMENTS	PHYSICAL ELEMENTS	Hydrography	Water Quality	Water Circulation	Wave Action	Sedimentation	Air Quality	Noise	BIOTIC ELEMENTS	Endangered Species	Marine Mammals	Spawning Habitat	Benthos	Marine Organisms (offshore)	Intertidal Flats	SOCIAL ELEMENTS	Natural Resources	Aesthetic Quality	Cultural Resources	Navigation Safety	Boating	ECONOMIC ELEMENTS	Commercial Shipping	Commercial Fishing	Land Use	Public Facilities	Employment	Energy	Local Government
PHYSICAL ELEMENTS																													
Hydrography				T	T	C																							
Water Quality				C																	T		T	T					
Water Circulation		T			C																								
Wave Action		C																					S						
Sedimentation					T																								
Air Quality																							S	T			T		
Noise																							S	T					
BIOTIC ELEMENTS																													
Endangered Species			C				T																		T				
Marine Mammals			C		S																								
Spawning Habitat			C		S	M							M	S	C														
Benthos		C	C	M	S	M					S																		
Marine Organisms			C	C	S	M							M																
Intertidal Flats		C	C	C	M	C					M			T															
SOCIAL ELEMENTS																													
Natural Resources																													
Aesthetic Quality			C				T																						
Cultural Resources					T																				T				
Navigation Safety		C				C																						M	
Boating					M																		T			M			
ECONOMIC ELEMENTS																													
Commercial Shipping		C			M					T							C			C								C	
Commercial Fishing					M					T		C					C			S			T						
Land Use																			M										
Public Facilities																					S			T					
Employment																	C												
Energy																	C												
Local Government																							T						

LEGEND: C = Critical Relationship
M = Moderate Relationship
S = Slight Relationship
T = Theoretical Relationship

relationships are the same for all plans, only one impact tree (Figure 3) was necessary. The following discussion will detail the differences and extent to which these effects vary among the detailed plans.

Water Quality.

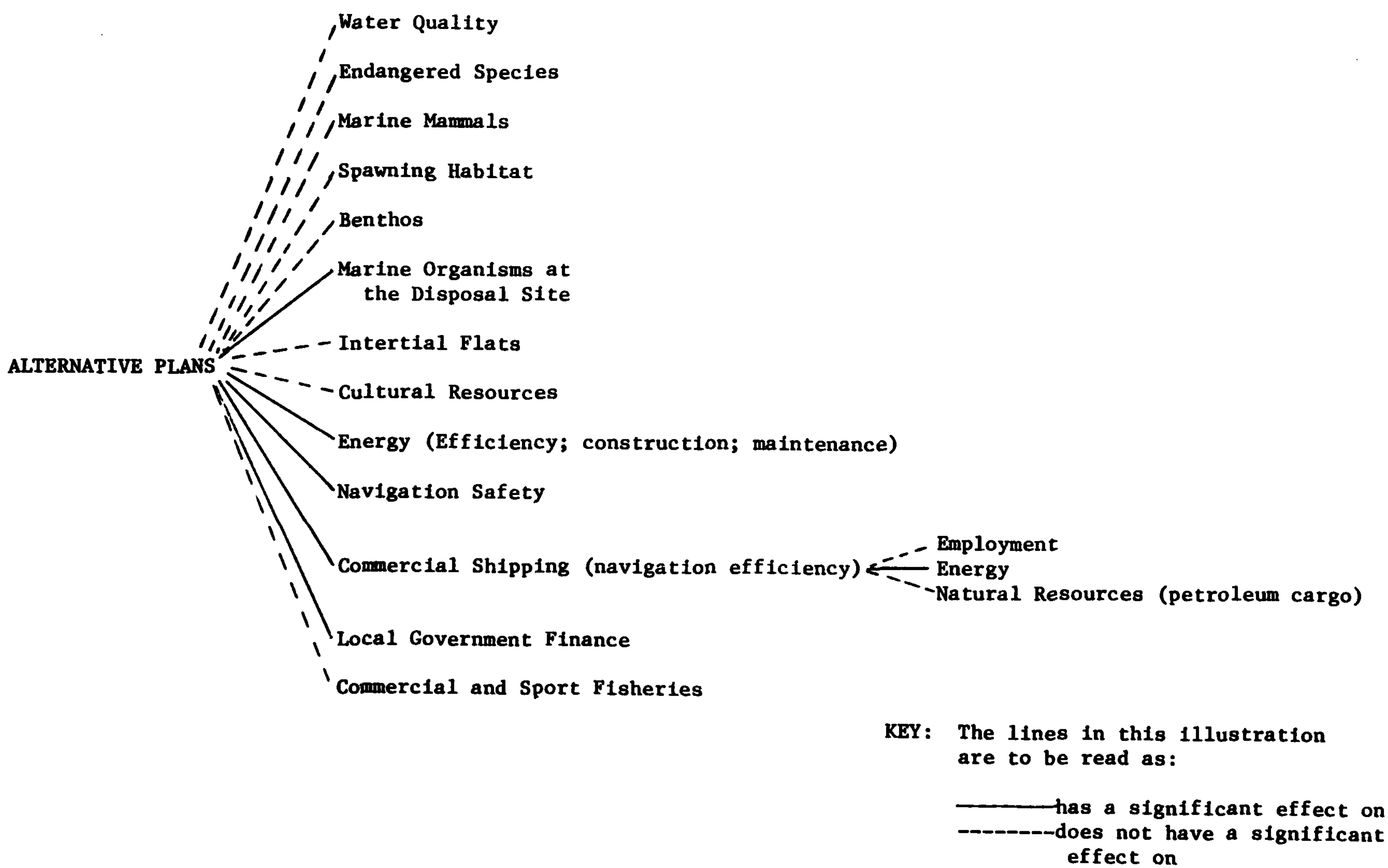
Plan A - No Action. There would be no significant change in the pH, salinity, temperature, concentrations of dissolved oxygen, suspended solids, heavy metals, petroleum hydrocarbons, and pesticides.

Plan B - Modified Authorized Project. Based on the monitoring of a clamshell dredge and barge open water disposal operation in San Francisco Bay, there would be no significant change in pH, salinity, or temperature due to these activities. It is expected that there will be two plumes generated due to the dredging activity: one from the bottom to midwater and the other on the surface. The Corps Dredge Disposal Study (DDS) showed that with the dredging of silts and days by clamshell operation, that the sediment concentrations in the bottom to midwater plume were several hundred milligrams (mg) per liter and was spread over an area 500m by 75m. The secondary surface plume extended about 300m and had concentrations of suspended solids of 100mg per liter or more. We expect similar concentrations in the study area near the oil dock and lower ones in entrance channel due to the presence of sand rather than silty clays. These effects would impact a limited area, but would be exerted continuously at the dredge sites. Elevated suspended solids are expected in the study area throughout the month dredging phase. Monitoring of concentrations of dissolved oxygen during dredging in San Francisco Bay, indicated that the concentration of dissolved oxygen was consistently affected. During sediment resuspension, oxygen consuming sediments, high in organics, cause a severe reduction in dissolved oxygen. This oxygen depression is expected to last the duration of the initial dredging project and each maintenance cycle.

Normal levels of suspended solids and dissolved oxygen are expected to return after dredging due to the flushing of the harbor with the diurnal tides and wind wave action.

The sediment-water interactions at the disposal site are determined primarily by the type of sediments disposed, their water content, the physical characteristics of the site (i.e. depth, currents) rather than the method of disposal. Sediment disposal results in very little disturbance of the upper water column. It is expected that a bottom or thermocline plume would be formed with the disposal of silts and clays from the oil dock area. The degree of horizontal dispersion would depend on the particles cohesion and their ability to entrain water during descent. The sandy material from the entrance channel would react more as discrete particles and would typically mound on the bottom.

FIGURE 3



ALTERNATIVE PLANS
Water Quality
Endangered Species
Marine Mammals
Spawning Habitat
Benthos
Marine Organisms at the Disposal Site
Intertial Flats
Cultural Resources
Energy (Efficiency; construction; maintenance)
Navigation Safety
Commercial Shipping (navigation efficiency)
Employment
Energy
Natural Resources (petroleum cargo)
Local Government Finance
Commercial and Sport Fisheries
KEY: The lines in this illustration are to be read as:
has a significant effect on
does not have a significant effect on

In the DDS, the release of sediments via a hopper dredge, resulted in the surface reduction of dissolved oxygen concentrations by 2 ppm which lasted about 2 minutes. There was a significant decrease of about 6 ppm in the concentration of dissolved oxygen on the bottom. Ambient concentrations were regained after an average of 3-4 minutes. Similar reductions are expected with barge disposal. Disposal during the summer may result in total oxygen depletion on the bottom due to the stratification. The silt and clay material may be partially trapped in the thermocline, reducing oxygen in that layer.

Based on laboratory elutriate tests and field monitoring, the release of heavy metals, chlorinated hydrocarbons and nitrogen compounds would be expected at the disposal site, only in the suspended solids plume. In the field, heavy metal levels were found to increase by several parts per billion (ppb) for durations less than one and one-half hours. Background levels of chlorinated hydrocarbons were augmented by releases in the ppb range for periods less than 30 minutes. Nitrate and ammonia nitrogen were temporarily increased by factors of 3.5 and 10 times over the background concentrations.

Results of the elutriate test showed that in most cases, the mean concentration of chemical contaminants were higher in the elutriate of the dredged material than in the disposal site water. However, these differences were not statistically significant ($\alpha = 0.05$). The field and laboratory differences do not appear to be biologically significant because of the extremely low concentrations of the chemical contaminants measured. Additionally under oxidizing conditions, the heavy metals should reassociate with the particulates almost immediately and ammonia should be oxidized to nitrate. These complexes would be relatively insoluble to organisms. Based on initial mixing calculations (see Appendix B) for barge disposal of silty clays at the offshore disposal site, only about 0.24% of the original liquid phase (elutriate) concentration, and about 0.11% of the suspended particulate phase concentration would be present in the disposal site waters.

All effects on water quality are expected to last 58 days during the initial construction period and 4 days per year over the life of the project. All water quality effects are unavoidable.

Plan C - Relocation of the Oil Dock to the Inner Breakwater. The effects on water quality would be the same as Plan B. However, the duration would be 103 days. It would require fewer days for the dredging (45 days) but additional time to rebuild the oil dock (+58 days during the initial construction). Maintenance dredging time would be the same as for Plan B (4 days). This rebuilding of the dock would cause considerable resuspension of sediments and concurrent oxygen depression.

BENTHOS

Plan A - There would be no change in the benthic community in the study area.

Plan B - Approximately 13.5 acres of benthic habitat would be disturbed in the harbor during construction and during biannual maintenance dredging, and 49 acres of habaitat at the disposal site would be covered by dredged material. Recolonization is expected at both sites. No change in diversity is anticipated.

The survivals of speckled sanddab and Dungeness crab were high (78%) in all treatments containing the liquid and suspended particulate phases of the dredged material. No significance difference in survival between the 100% phase concentration and the control was detected.

In the 10-day bioassay tests using the dredged material and a clean reference material, there was 100 percent survival of the polychaete worm between the dredged material treatment (98.5%) and the reference sediment treatment (99%).

There were no detectable levels of chlorinated hydrocarbons on PCB's in the tissue of the sea cucumbers after 10-days in the dredged material. Levels of cadmium, mercury, and petroleum hydrocarbons in sea cucumbers in the dredged material were either equal to or less than the levels in tissues of cucumbers in reference material. Average phenol concentrations were higher in tissue samples from organisms exposed to dredged materials (66 ppb) than in tissue samples from organisms exposed to reference material (30 ppb) but these were not statistically significant ($\alpha = 0.05$).

Based on the bioassay and bioaccumulation results, we conclude that there is no potential for adverse contaminant uptake in benthos at the disposal site due to the dumping of dredged material.

Plan C - Approximately 12 acres of benthic habitat would be disturbed at the dredge site due to constructin and biannual maintenance dredging. The bioassay and bioaccumulation results apply to this plan as well as Plan B since the dredged material is the same and only the quantities vary.

Spawning Habitat

Plan A - There would be no change in the spawning habitat in the harbor. The volume of water available in the harbor to fish species for spawning is about 10.7 million cubic yards (m cy).

Plan B - There would be no significant impacts on this resource since dredging has been scheduled for August and September to avoid peak habitat use in the winter. The volume of water available to fish species would be increased to about 10.8 m cy.

Plan C - Same as Plan B.

Marine Organisms at the Disposal Site

Plan A - There will be no change in the diversity or abundance of organisms at the disposal site.

Plan B - Percent survival of the zooplankton <u>Calanus pacificus</u> in the 4-day liquid and suspended particulate phases bioassay tests was high (75%). There were no significant differences in survival of this species between the controls and the liquid and suspended particulate phase dredged material treatments. Based on these results, it is concluded that there is no potential for adverse effects in these organisms due to dumping of dredged material. Suspended solids in the water column may provide food for some marine organisms at the dump site. There may be a short-term reduction in photosynthetic rate due to the decreased light transmission with the increased suspended solids.

Plan C - Same as Plan B.

<u>Endangered or Threatened Species</u>

Plan A - There would be no change in the condition of these populations or in their critical habitats.

Plan B - Only the California brown pelican and the gray whale are found near the study area. There would be no adverse impacts on the brown pelican or its habitat due to project construction or maintenance. Dredging has been scheduled to begin in August to avoid the migration of the gray whales.

Plan C - Same as Plan B.

<u>Commercial and Sport Fisheries</u>

Plan A - Fishing vessels will continue to encounter navigation safety problems when entering the harbor and may have to wait on the tides before entering due to the shoaling of the entrance channel.

Plan B - Commercial fisheries would not be significantly impacted by the project since most occur well offshore out of the study area. Fishing near the oil dock is prohibited. Some fishing vessels may suffer delays on existing the harbor during the 10 days of initial dredging in the entrance channel, and during the 4 days of biannual maintenance dredging. The winter sportfishery would not be impacted since the dredging was scheduled to begin in August to prevent any losses to this resource.

Plan C - Same as Plan B.

<u>Marine Mammals</u>

Plan A - There will be no change in the populations of these animals.

Plan B - Since these organisms are mobile, we expect them to move out of the way when the dredge is in the harbor. There would be no adverse effect on their population size or condition due to project implementation.

Plan C - Same as Plan B.

Intertidal Flat

Plan A - The existing available intertidal area totals 416.8 yd^2. The Harbor Districts Port Land Use Plan calls for a new marina and associated facilities that will reduce the intertidal area to 272.7 yd^2 by about 1984.

Plan B - There would be no change in the area of intertidal flat due to project implementation. All dredged materials would be placed in the ocean.

Plan C - Same as Plan B.

Local Government Finance. This component is considered significant since the local sponsor, the Crescent City Harbor District, must provide funds for a portion of the project costs. Its funding comes from tax revenues and from charges levied on harbor facilities.

Plan A - There would be no change in the local government finance.

Plan B - The local sponsor would have to provide $540,000 to implement this plan.

Plan C - The Crescent City Harbor District would need to provide funds in excess of $1,000,000 in order to implement this plan.

Energy. Conservation of energy resources has recently become a National concern. Energy conservation may be evaluated qualitatively in terms of (1) energy used to unload half of the cargo; (2) energy used in annual maintenance dredging; and (3) energy used in project construction.

Beneficial impacts of navigation improvements would occur due to fuel savings. In addition to increasing efficiency in barge operation, maneuverability would increase in the channel. Some energy would be required for initial construction and biannual maintenance dredging and disposal.

Plan A - There would be a net increase in energy consumption with this plan if navigation improvements were not implemented. Barges would continue to make extra trips to unload fuel. Some may run aground due to shoaling and unsafe maneuvering.

Plan B - There would be a more efficient use of energy with this plan due to reduced hazards and increased maneuverability. Energy would be required for initial construction and biannual maintenance dredging.

Plan C - Increased maneuverability and reduced navigation hazards would increase energy efficiency. Less Energy would be required for construction and biannual maintenance dredging with this plan than with Plan B.

Navigation Safety. In recent years, harbor users have begun to experience navigational difficulties in entering and maneuvering in the harbor. This is due to a shoal forming between Round Rock and Fauntleroy Rock which, as of August 1978, was approximately 1,000 feet long and six feet

higher than the surrounding ocean. It was estimated that the shoal is accreting at an annual rate of one foot in height, two feet in width and 60 feet in length, amounting to a volumetric measure of 15,000 cubic yards. This shoal is thought to be the cause of a large swell across the entrance channel.

Plan A - Navigation hazards would remain. Maneuverability in the channel would be severely limiting and hazardous.

Plan B - Navigation hazards in the entrance channel would be eliminated and maneuverability inside the harbor would improve.

Plan C - Same as Plan B.

Navigation Efficiency. Since 1971, petroleum products have represented more than 90% of the total commerce in Crescent City Harbor. The existing -12 foot MLLW depth in the Inner Harbor is insufficient to accommodate the drafts of fully loaded petroleum barge and tug combinations currently used in the San Francisco to Crescent City petroleum barge trade. The restrictive Harbor depth has caused economic inefficiencies in the transportation of petroleum products by barge. Barges must be lightened by 47% at Eureka or Coos Bay in order to enter Crescent City Harbor. On the average, a total of 1,862,000 barrels of petroleum products arrive annually by barge in Crescent City Harbor. Under the without project conditions, the CC/CB split requires 10.2 trips annually and a total of 1,180 hours of travel time, including tidal delays. The E/CC split requires 36.5 trips and travel time of 3,426. hours annually, includng tidal delays.

Future shipments of petroleum products through Crescent City Harbor are not expected to change from the base period level over the next fifty years. This is based on the latest DOE Petroleum forecasts for the National level as well as for the Petroleum Administration for Defense Area number five (PAD-5). This area encompasses a six state region including California and Oregon as well as Nevada, Washington, Hawaii, and Alaska.

Plan A - Barges would continue to lighten about 47% of the total petroleum shipped from San Francisco at either Coos Bay or Eureka in order to gain entry into Crescent City.

Plan B - Shipping efficiency would increase by reducing transportation costs. The least costly shipping alternative would be direct hauls using a UT-101 tug and barge combination. With direct loading, a round-trip would require 64.7 hours to Eureak, 72.4 hours to Crescent City, and 99.4 hours to Coos Bay. Project benefits on the difference in costs for transporting 1,862,000 barrels of petroleum products under with and without conditions from San Francisco to Crescent City Harbor. Average annual benefits would be $585,000.

Plan C - Same as Plan B.

TABLE 2

COMPARATIVE IMPACTS OF ALTERNATIVES

Plans	Water Quality	Benthos	Spawning Habitat	Marine Organisms at Disposal Site
	SIGNIFICANT RESOURCES			
...e Condition (1981)	Temperature 7.5-14.0° C PH 7.3-8.5 Conductivity 43,400-50,850 umhos Dissolved Oxygen (DO) 0.6-10.5 mgl Heavy Metals Below State Criteria Oil & grease " PCB's " Chlorinated hydrocarbons (TICH) " Suspended Solids - Some present	Available: 162 acres of sandy benthic habitat at disposal site 450 acres of sandy & silty benthic habitat in the harbor. Impact: 0.005 acres disturbed annually. Survival: 96-100% in controls for for sanddabs, dungenan crabs, polychaete worms, gastropods, and sea cucumbers.	Available: 10.7 million cubic yards of water.	Survival: 85% of copepods in controls.
Plan A ... Federal Action	Temperature - no substantial charge PH " conductivity " Dissolved oxygen - will decrease for 14 days. Heavy metals " Oil & grease " PCB's " TICH " Suspended Solids - will increase for 14 days.	Available: 162 acres of sandy benthic habitat at disposal site. 450 acres of sandy & silty benthic habitat in harbor. Impact: 0.005 acres disturbed annually by maintenance dreging. Survival: No substantial difference from the base condition.	Available: 10.7 million cubic yards of water	Survival: No substantial change from the base condition.
Plan B ...dified Authorized Plan	Temperature - no substantial impact PH " conductivity " DO - will decrease to zero for 58 days initially/ 10 days biannually. Heavy metals - no substantial impact Oil & grease " PCB's " TICH " Suspended Solids - will increase for 58 days initially/ 10 days biannually.	Available: 113 acres of sandy benthic habitat at disposal site. 437 acres of sandy & silty benthic habitat. Impact: 49 acres of sandy benthic habitat may be covered with silts and organics. 13 acres of habitat in the harbor will be disturbed initially and biannually. Survival: No significant decrease (P 95%) in any of the species tested.	Available: 11.3 million cubic yards. Impact: Slight increase in volume	Survival: No significant decrease (p 95%) in copepods.

TABLE 2

COMPARATIVE IMPACTS OF ALTERNATIVES
(Cont'd)

Plans	SIGNIFICANT RESOURCES: Water Quality	Benthos	Spawning Habitat	Many Organisms at Disposal Site
Plan C 1 Dock Relocation	Temperature - no substantial impact PH " conductivity " DO - will decrease to zero for 103 days initially Heavy metals - no substantial impact Oil & grease " PCBS " TICH " Suspended Solids - will increase for 103 days initially/ 9 days biannually.	Available: 113 acres sandy benthic habitat at disposal site. 438 acres of sandy & silty habitat in harbor. Impact: 49 acres at disposal site may be covered with silts and organics. 12 acres in harbor will be disturbed initially & biannually. Survival: No significant decrease (P 95%) in any of the species tested.	Available: 11.3 million cubic yards. Impact: Slight increase in volume.	Survival: No significant decrease (P 95%) in copepods.

TABLE 2

COMPARATIVE IMPACTS OF ALTERNATIVES
(Cont'd)

	SIGNIFICANT RESOURCES			
Plans	Endangered or Threatened Species	Commercial & Sport Fishing	Marine Mammals	Intertidal Flat
ase Conditions (1981)	Present: Brown Pelicans roosting on Pelican Rock Gray whale migrations nearshore.	Condition: Navigation problems endering harbor-groundings and delays.	Present: Gray whales nearshore migration. Other whales far offshore migration. Seals and Sealions feeding in harbor.	Available in harbor: 417,000 yd^2
Plan A o Federal Action	No change from the base conditions.	No change from the base conditions.	No change from the base conditions.	Available in harbor: 273,000 yd^2
Plan B dified Authorized Plan	No effect	Navigation problems will no longer occur. Delays may be experienced during 15 days of initially dredging the entrance channel and 3 days biannually.	No substantial impact.	Available in harbor: 273,000 yd^2 Impact: None
Plan C elocation of Oil Dock	No effect	Navigation problems will no longer occur. Delays may be experienced during 15 days of initial dredging in entrance channel and 3 days biannually.	No substantial impact.	Available in harbor: 273,000 yd^2 Impact: None

TABLE 2

COMPARATIVE IMPACTS OF ALTERNATIVES
(Cont'd)

	SIGNIFICANT RESOURCES			
Plans	Local Government Finance	Energy	Navigation Safety	Navigation Efficiency
...se Conditions (1981)	Funding generated from tax revenues and changes levied on habor facilities.	Energy consumption due to inefficient operation of loading and unloading has increased in recent years.	Harbor users have begun to experience difficulties in entering and maneurving in the harbor.	Fully loaded barge and tug operators can bot be accommodated at the harbor.
Plan A ...o Federal Action	No change made to local government.	Energy consumption would increase as barges would continue to make extra trips and operate efficiency.	Annual rate of accretion would continue to make navigation in the harbor hazardous.	Continued lightening of about 47% of petroleum shipped from San Francisco.
Plan B ...odified Authorized Plan	$23,000 cost to local government.	Energy requirements for initial construction and bi*annual maintenance.* More efficient use of the harbor would reduce energy consumption over Plan A.	Navigational hazards would be eliminated and maneuverability would be improved.	Transportation costs would be reduced. Average annual benefits expected total: $585,000.
Plan C ...elocation of Oil Dock	$1,080,000 cost to local government.	Less energy would be required for initial construction and by annual maintenance than Plan B. More efficient use of the harbor would also reduce energy consumption over Plan B.	Same as Plan B.	Same as Plan B.

PUBLIC INVOLVEMENT

Public Involvement Program. On 28 November 1979, a scoping meeting was held by representatives of the Corps of Engineers to discuss the navigation improvements at Cresent City Harbor. Only four public agencies attended: the U.S. Fish and Wildlife Service, the State Department of Fish and Game, the National Marine Fisheries Service, and the U.S. Environmental Protection Agency. The greatest concern expressed at this meeeting was the method of construction. The extensive blasting program was deemed to be significantly detrimental to aquatic resources. Alternative methods of construction were suggested. Since the scoping meeting, an alternative method of construction has been selected.

Agency Coordination. Prior to the November 1979 scoping meeting, coordination with the U.S. Fish and Wildlife Service was initiated on 4 January 1979 with a request for input on effects of blasting on the marine environment at Crescent City Harbor. A list of endangered species was also requested on 20 June 1979 and a list was received on 18 September 1979. An updated listing was requested on 20 April 1981.

On 25 January 1980 the Corps of Engineers issued a Public Notice regarding the Section 404 (b) Evaluation for the Crescent City Harbor improvements. On 9 May 1980 the State Regional Water Qulity Control Board waived the certification requirements. By doing so, the project satisfied the Section 404 (b) requirements.

Other required coordination included contact with the State Historic Preservation Officer (see Appendix D), who did not identify any properties on, or eligible to, the National Register of Historic Places. and the California Coastal Commission which did not have comments at the time of the scoping meeting and were unable to attend.

Statement Recipients.

(1) Congressional

Senator Cranston
Senator S.I. Hayakawa
Congressman Don Clausen
Congressman Phillip Burton

(2) Federal

U.S. Department of Commerce
- San Francisco Field Office
- National Oceanic Survey, NOAA
- Economic Development Administration
- Maritime Administration
- National Marine Fisheries Service

(2) Federal (cont'd)

U.S. Department of the Interior
- Bureau of Indian Affairs
- Fish and Wildlife Service
- Endangered Species Office
- Geological Survey
- Advisory Council Historic Preservation
- Office of Environmental Project Review
- Forest Service, Six Rivers National Forest

U.S. Environmental Protection Agency, Region IX
U.S. Environmental Protection Agency, Washington D.C.
U.S. Department of the Navy
U.S. Department of Transportation
- Coast Guard District

Federal Maritime Commission

(3) State

State Senator Barry Keene
State Assemblyman Doug Bosco
The Resources Agency
State Historic Preservation Officer
State Water Resources Control Board, North Coast Region
State Lands Commission
Office of Planning and Research
California Coastal Commission
Department of Fish and Game

(4) City and County

City Manager, Crescent City
Mayor, Crescent City
Crescent City Harbor District
Department of Public Works, Crescent City
County Board of Supervisors, Del Norte County
County Administrator, Del Norte County
Humboldt County Planning Department
Humboldt State University
Mendocino Beacon

(5) Individuals

Humboldt Dock and Shipping Company
North Coast Environmental Center
Mr. James Hooper
Northwest Indian Cemetery Protective Association
Pacific Lumber Company
Sonoma State University, Anthropology Studies Center
Mr. Rudolf Becking
California Trout, Inc.

APPENDIX A

SECTION 404(b) EVALUATION
CRESCENT CITY HARBOR NAVIGATION PROJECT
DEL NORTE COUNTY, CALIFORNIA

APPENDIX A

SECTION 404(b) EVALUATION
CRESCENT CITY HARBOR NAVIGATION PROJECT
DEL NORTE COUNTY, CALIFORNIA

The U. S. Army corps of Engineers is required to evaluate and make certain determinations on the discharge of dredged material into navigable waters and into the territorial sea according to the criteria specified in Section 404 of the Clean Water Act (CWA) and Section 103 of the marine Protection, Research, and Sanctuaries Act (MPRSA). The U. S. Army Corps of Engineers must obtain a California State water quality certificate from the State Water Resources Control Board unless exempted by congress. This evaluation addresses the criteria specified in both Section 404 of the CWA and Section 103 of the MPRSA.

1. Project Description.

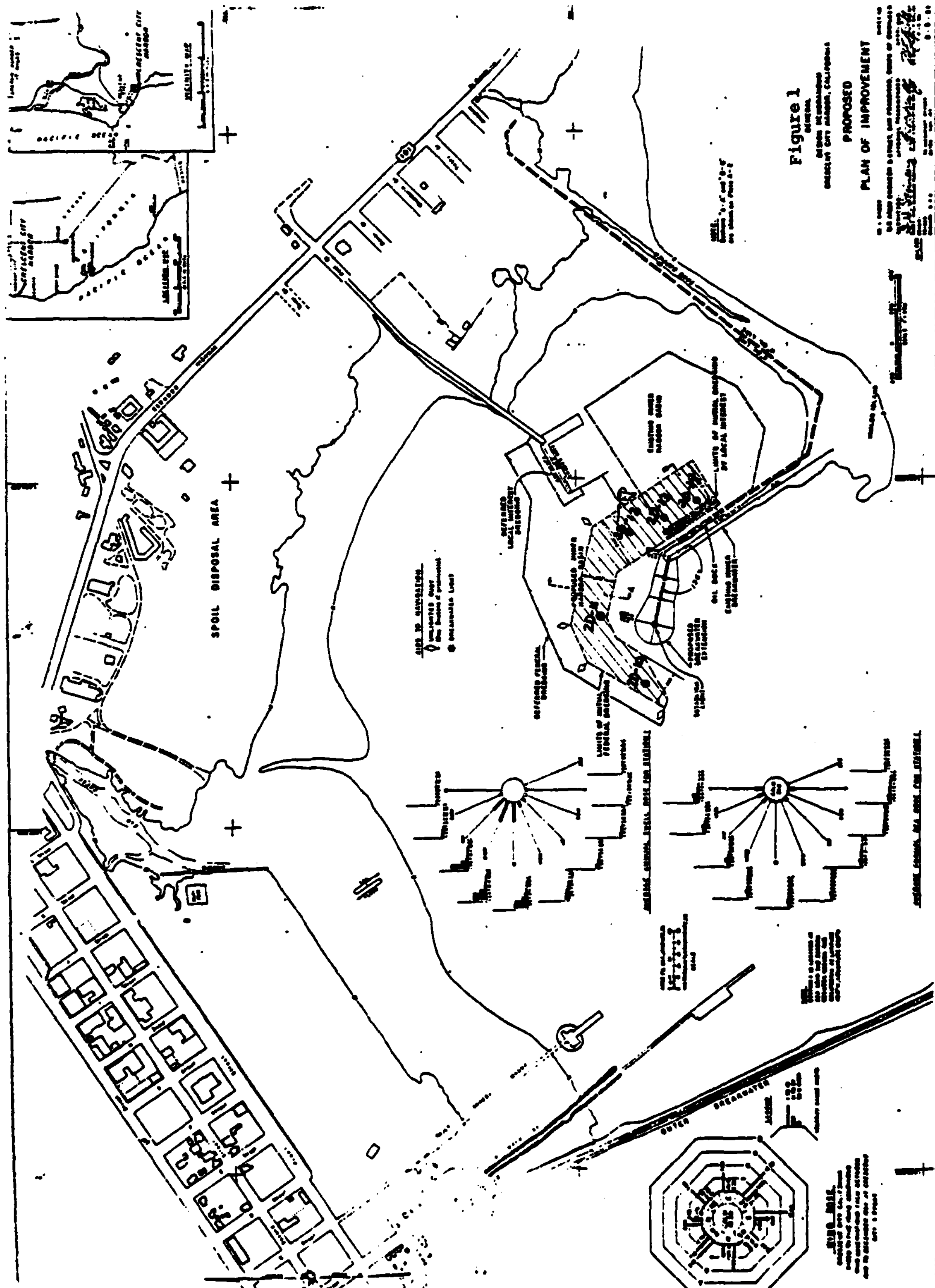
The River and Harbor Act of 1965 authorized the inner breakwater extension and deepening the existing inner harbor channel of the Crescent City harbor Navigation Project. The San Francisco District, Corps of Engineers completed the inner breakwater extension protion of the project in 1973 and is presently investigating completing the authorized project by deepending the existing inner harbor channel from a depth of 12 feet to a depth of 20 feet. (Figure 1).

a. Description of the proposed discharge of dredged or fill material.

(1) General characteristics of material. the harbor bottom is covered by about 4 feet of sediment with numerous rocky pinnacles projecting above the general bottom. The overlying sediments are a mixture of silts and ssnds; the rocks are hard, consolidated sandstones, shales and greenstones.

(2) Quantity of material proposed for discharge. Approximately 138,000 cy of sand and shale would be removed during initial construction. Biannual maintenance dredging of about 31,500 cy from the inner basin and 11,500 cy from the entrance channel would also be necessary.

(3) Source of material. Sand is derived from outside of the harbor entrance on the flood tide. Erosion of the beach between Elk Creek and the small boat basin also contributes to sedimentation in the harbor. Silts enter the harbor mainly during winter storms and during periods of heavy rainfall from Elk Creek and the Klamath River.



Page 2

b. Description of the proposed discharge site for dredged or fill material.

(1) Type of site. The proposed site is an ocean disposal site which was interim designated by EPA in the 11 January 1977 Federal Register, Volume 42, Number 7 (40 CFR 228.12).

(2) Location and areal extent. The proposed site is located at 124°12'00"W and 41°43'15"N on a 186° magetic north heading, 2,100 meters from the tip of the east jetty. The disposal site is 914 meters in diameter and is located in approximately 27 meters of water. (Figure 2).

(3) The method of discharge would be by barge.

(4) The dumping is scheduled to begin in the late summer of 1982 and should continue for a period of 2 months. maintenance dredging disposal would be on a yearly cycle.

(5) known historical uses of the proposed disposal site. The site has not been used previously.

(6) Existence and documented effects of other authorized dumpings on this site. No other authorized dumpings have occurred on this site.

(7) Projected life of discharge site. The site would be able to be used indifinitely and is expected to be maintained under the present program as promulgated by the Maine Protection, Research, and Sanctuaries Act of 1972.

(8) Bathymetry. The sight has numerous rock pinnalces in the northeastern quadrant. The remainder of the site has a relatively flat bottom.

2. Physical Effects

a. Will wetlands be lost? No wetlands will be lost or impacted by the proposed dumping at this disposal site.

b. What will be the effects on the water column as to:

(1) Light transmission. During disposal, short-term increases in turbidity and associated reduction in light transmission are expected.

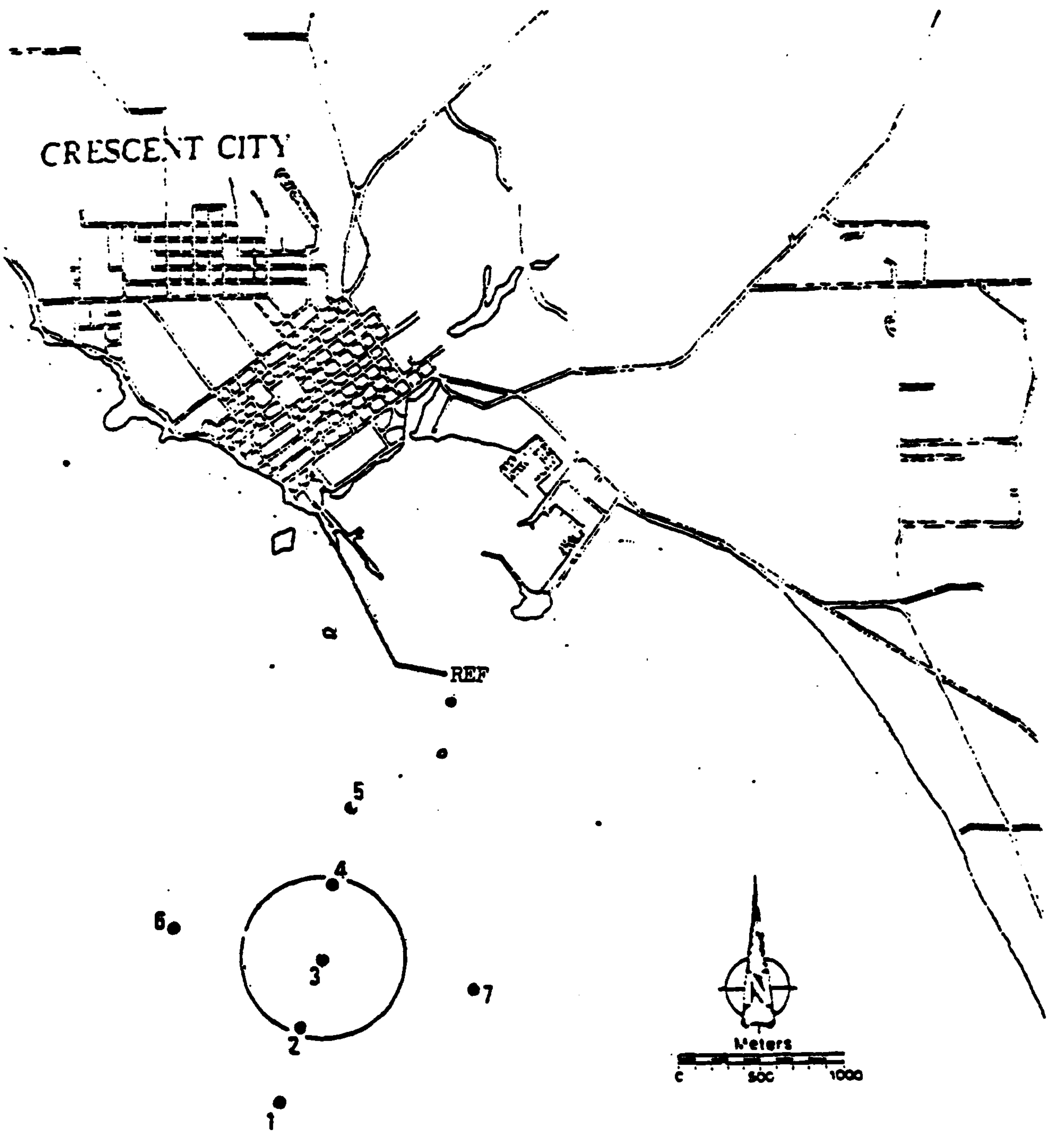


FIGURE 2 Disposal site stations for water and sediment sampling near Crescent City Harbor, California, June 1979

(2) Aesthetic values. Short-term adverse effects of ocean disposal are anticipated. Rocks and sand would sink rapidly to the bottom and would not have an impact on the water column. Silts and clays would be trapped in the upper water column due to the presence of a thermocline and halocline. Dispersion would remove the effect within several hours.

(3) Direct effects on:

(a) Nekton - These effects will be localized and short-term. These free swimming organisms are able to move from the site. There may be beneficial impacts as dredge material may provide food for such organisms.

(b) Plankton - The effects will be localized and short-term as mixing and dispersion occurs. Reduction in light transmission may temporarily affect the ability of phytoplankton to synthesize carbohydrates.

c. What will be the significance in covering the benthos as to:

(1) Relative extent of loss. A solid phase bioassay was performed to measure the potential for impact outside the disposal site after the 4-hour initial mixing period. Out of a total of 1,200 organisms tested in the solid phase, only 5 died during the test (3 in the dredge material and 2 in the reference material). Based on the results of the bioassay test, no losses due to chemical impacts are expected. Some deaths due to smothering are expected to occur inside the disposal site boundary. These losses should be minimal due to the relatively small quantity of material to be discharged and the size of the disposal site.

(2) Time required for repopulation. Few studies have been done to determine the time required for repopulation. This parameter varies by species and with frequency of disposal operations. Rapid repopulation from contiguous areas is expected to occur a few months after the construction period.

(3) Change in benthic community. No change is expected to occur due to the small quantity of sediment disposed. Few, if any, silts and clays are expected to reach the bottom at the proposed disposal site due to the presence of a thermocline and halocline. These sediments would be so dispersed that bottom impacts are expected to be minimal. Since the sands and rock to be dredged are similar to the disposal site sediments, no change in the community is expected.

(4) Effect on the other species which are dependent on the benthos. There would be little or no effect on these species since they are mobile and may move if their food supply is limited.

d. What will be the change in:

(1) Bottom geometry. Initially there may be some mounding of rocks and sand. These should be dispersed during storm conditions.

(2) Substrate composition. There would be no significant change in substrate composition. Only small quantities of silts are expected to reach the disposal site bottom. Most would be dispersed by currents and tide. The sand in the dredge material is similar to the sediments at the disposal site. Analysis of sediments at the disposal site indicated the predominance of medium and fine grained sands (see Table 1).

(3) Salinity gradients. No change is expected in the salinity gradients at the disposal site. The dredge site is in waters of the same salinity as the disposal site. Disposal should not impact or change the halocline.

(4) Alteration of biological communities due to exchange of constituents between sediments and overlying water. No change is expected in the communities. The sediments appear to bind contaminants in the water. There was no significant difference in the uptake of contaminants in the sea cucumber from the reference or dredge site. There were no detectable levels of chlorinated hydrocarbons of polychlorinated biphenyls (PCB's) in any of the cucumber tissue samples. Levels of cadmium, mercury, and petroleum hydrocarbons in cucumber tissues held in dredge material were either equal to or less than the levels in cucumber tissues held in reference material. Average phenol concentrations were higher in tissue samples from organisms exposed to dredge material (66 ppb) than in tissue samples from organisms exposed to reference material (33 ppb) but these differences were not statistically significant. Water column communities are not expected to be significantly altered since the exposure is short term and temporary. It was determined that after 4 hours of initial mixing only about 0.24% of the original liquid phase concentration, and about 0.11% of the suspended particulate phase concentration would be present in the disposal site waters above the thermocline (halocline).

3. <u>Chemical-Biological Interactive Effects</u>

a. Does material meet the exclusion criteria? It does not.

TABLE 1 PERCENTAGE (BY WEIGHT) RETAINED ON VARIOUS SIEVES OF SEDIMENTS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

		Station												
		Disposal Site							Reference Site					
Sediment Classification	Sieve Size[a]	1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Gravel	10 (2,000)	0.3	0.2	0.5	1.8	0.1	0.1	42.0	2.6	1.0	3.0	1.3	0.9	1.5
Coarse sand	20 (850)	1.0	0.6	1.4	0.6	0.7	0.7	13.9	2.2	1.3	1.3	1.2	1.9	2.3
Coarse sand	30 (500)	1.5	0.3	0.8	0.4	0.4	0.3	3.8	3.3	0.9	0.8	0.7	0.6	0.9
Medium sand	100 (150)	14.5	11.4	28.6	21.3	21.0	24.3	4.7	39.6	56.6	39	24.1	42.4	78.2
Fine sand	200 (75)	79.1	82.6	67.2	72.4	70.2	68.7	13.7	30.7	39.4	55.3	70.2	53.4	17.0
Silt	Pan (<75)	3.6	4.9	1.5	3.5	7.3	5.9	21.9	21.6	0.9	0.6	2.5	0.9	0.1

(a) Opening size (μm) is given in parentheses.

b. Water column effects of chemical constituents. Are contaminants released? If so, at what levels? Based on the elutriate analysis of the dredge material and the chemical analysis of water at the disposal site, it appears that the sediments are binding chemicals rather than releasing them.

c. Effects of chemical constituents on benthos. The solid phase bioassay was conducted for 10 days to determine the effects on three species of benthic organisms which use three different feeding mechanisms. There were no significant differences in survival for any of the species tested between the reference and the dredge site sediments. Since sensitive species were used, it has been determined that there is no potential for adverse impact due to the disposal of this dredged material.

4. Dredge and Disposal Site Comparison

a. Total sediment analysis. Five representative sediment samples were taken at the dredge site during late January 1979 (see Figure 1). Elutriate analysis on these sediments were performed using disposal site water (see Table 2). Seven stations in and around the disposal site were sampled in June 1979 (see Figure 2). Additionally, six samples were taken at several offshore locations (see Figure 3). Elutriate tests were conducted on these samples using disposal site water (see Table 3). A summary of the results follows.

The analysis of dredge and disposal site sediments revealed no detectable levels of mercury, cadmium, and lead. There were no detectable levels of copper, zinc, oil and grease, chlorinated hydrocarbons, and PCB's in the disposal site sediments. Concentrations of these constituents were detected at the dredge site, although in concentrations less than the detection limit used in the analysis of the disposal site sediments. Phenol concentrations of 0.004 ppm were detected at one dredge site station and concentrations of 0.005 ppm were measured at two disposal site stations.

b. Biological community structure analysis. Since quantities of dredge material are relatively small and testing of the material resulted in no potential for adverse impact on the community at the disposal site, such an analysis was deemed unnecessary.

5. Review of Applicable Water Quality Standards

a. Constituent Concentrations. Disposal site water was analyzed for background levels of contaminants both in January and June 1979 (see Figure 2 and Tables 4 and 5). Elutriate analyses on the dredge disposal and reference site sediments were compared to each other and to the Environmental Protection Agency (EPA) Quality Criteria for Water and the State Water Resources Control Board (SWRCB) Water Quality Control Plan for Ocean Waters of California (see Table 6). The results are summarized below.

TABLE 2 CONCENTRATIONS OF CHEMICAL CONSTITUENTS OF SEDIMENT SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE SITE, JANUARY 1979

Location	2D-10	2D-11	2D-12	2D-13	2D-14
Reported as mg/liter					
Mercury	0.0005-	0.0005-	0.0005-	0.0005-	0.0005-
Cadmium	0.001	0.001-	0.001-	0.001-	0.001-
Copper	0.001-	0.001-	0.001-	0.005	0.002
Zinc	0.020	0.010	0.010-	0.010-	0.010
Lead	0.004-	0.004-	0.004-	0.004-	0.004-
Oil and Grease	1-	1-	1-	2	2
Residual Petroleum Hydrocarbons	1-	1-	1-	1-	1-
Phenol	0.002	0.004	0.002	0.001	0.001
Reported as Micrograms/liter					
Persistent Organohalogens	0.03	0.05	0.10	0.25	0.30
Pesticides other that the Organohalogens	0.01-	0.01-	0.01-	0.01-	0.01-

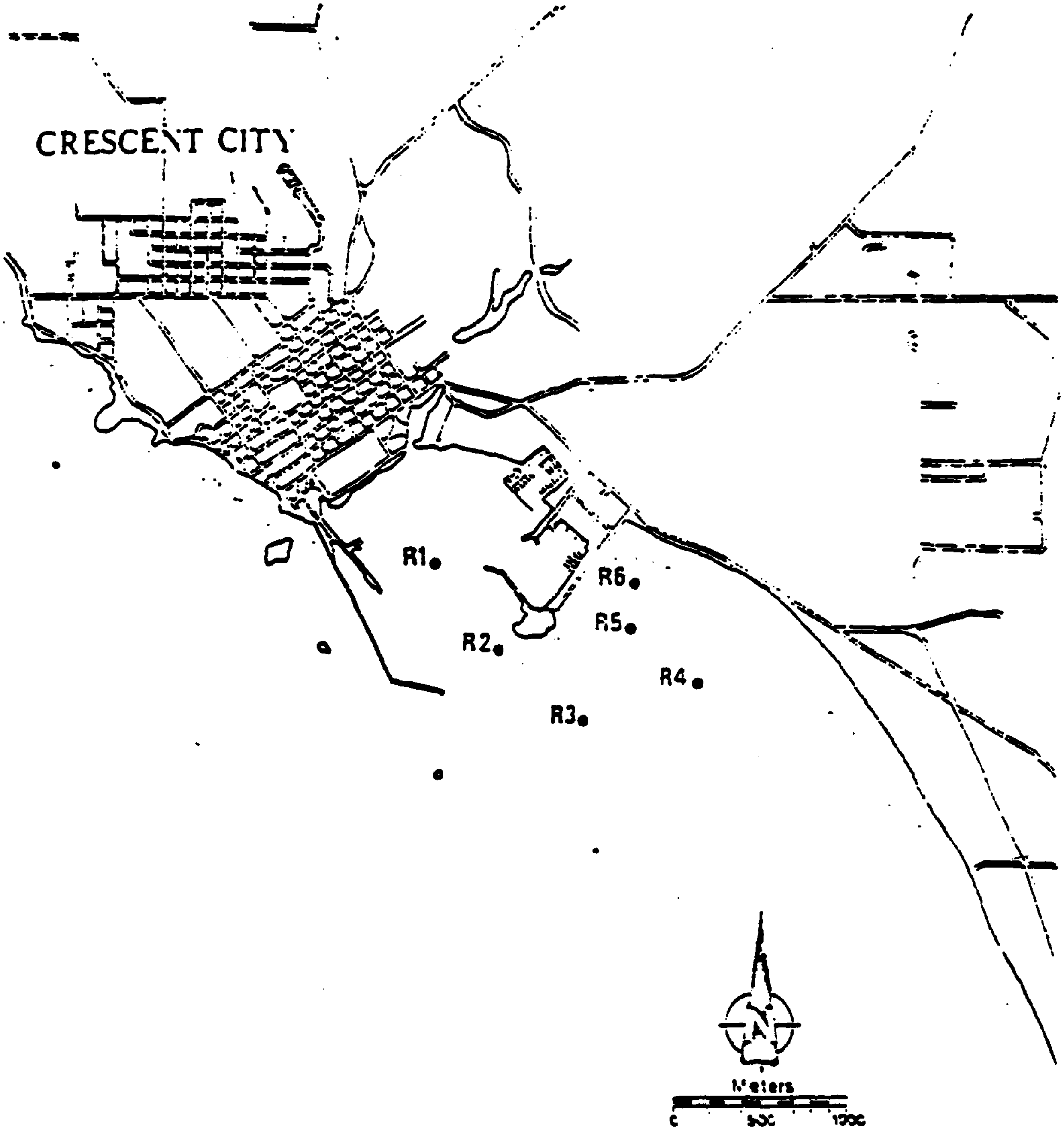


FIGURE 3 Station locations of six reference sites for water and sediment sampling near Cresecent City Harbor, California, June June, 1979

TABLE 3 CONCENTRATIONS (ppm.) OF CHEMICAL CONSTITUENTS OF SEDIMENT SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Chemical Constituent	Field Blank	Station: Disposal Site 1	2	3	4	5	6	7	Reference Site R-1	R-2	R-3	R-4	R-5	R-6
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc	<0.1	<0.1	<0.1	<0.1	<0.1	≤0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Phenol	<0.004	<0.004	<0.004	<0.004	<0.004	0.005	0.005	<0.004	<0.004	<0.004	≤0.004	0.004	<0.004	0.004
Oil & Grease (Freon extractable)	<1	≤1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorinated hydrocarbons	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 4 CONCENTRATIONS OF CHEMICAL CONSTITUENTS OF WATER SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE AND DISPOSAL SITES, JANUARY 1979

Location	Dredge Site 2D-12	Disposal Sites 1	3	5	Reference
Reported as mg/liter					
Mercury	0.0006	0.0005	0.0005-	0.0005-	0.0005
Cadmium	0.002	0.001	0.001	0.001-	0.001
Copper	0.003	0.005	0.001-	0.001-	0.002
Zinc	0.010-	0.010-	0.010-	0.010-	0.010-
Lead	0.004-	0.004-	0.004-	0.004-	0.004-
Oil and Grease	1	2	2	2	1
Residual Petroleum Hydrocarbons	1-	1-	1-	1-	1-
Phenol	0.002	0.002	0.002	0.001-	0.002
Reported as Micrograms/liter					
Persistent Organohalogens	0.10	0.10	0.09	0.05	0.10
Pesticides other than the Organohalogens	0.01-	0.01-	0.01-	0.01-	0.01-

TABLE 5 CONCENTRATIONS (ppm) OF CHEMICAL CONSTITUENTS OF WATER SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Chemical Constituent	Disposal Site Stations 1 Surface	1 Bottom	2 Surface	2 Bottom	3 Surface	3 Bottom	4 Surface	4 Bottom	5 Surface	5 Bottom	6 Surface	6 Bottom	7 Surface	7 Bottom
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	<0.002	<0.002
Zinc	<0.1	<0.1	--	--	<0.1	<0.1	--	--	<0.1	<0.1	--	--		
Copper	<0.08	<0.08	--	--	<0.08	<0.08	--	--	<0.08	<0.08	--	--	--	--
Phenol	<0.004	<0.004	--	--	<0.004	<0.004	--	--	<0.004	<0.004	--	--	--	--
Oil & Grease (Freon extractable)	<1	<1	--	--	<1	<1	--	--	<1	<1	--	--	--	--
Chlorinated hydrocarbons	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Note: -- means no chemical analysis was performed on that sample.

TABLE 6

Applicable Water Quality Standards

Chemical Constituents	Environmental Protection Agency Quality Criteria For Water (1976)	State Water Resources Control Board Water Quality Control (1976) Plan for Ocean Waters of California
		Instantaneous maximum
Mercury (mg/l)	0.0001	0.0014
Cadmium (mg/l)	0.005	0.03
Copper (mg/l)	1[a]	0.02
Zinc (mg/l)	5[a]	0.2
Lead (mg/l)	0.05[a]	0.08
Oil and Grease (mg/l)	NC[b]	NC
Petroleum hydrocarbons (mg/l)	NC	NC
Phenolic Compounds (mg/l)	0.001[a] (phenol)	0.3
Total		
Chlorinated Pesticides and PCB's (mg/l)	NC	0.006[c]

[a] Domestic water supply criteria

[b] No Criteria

[c] These shall be measured by summing the individual concentrations of DDT, DDD, DDE, aldrin, BHC, chlordane, endrin, heptachlor, Lindane, dieldrin and Polychlorinated biphnyls.

EPA has established standards for marine waters for aquatic life for only two heavy metals: mercury and cadmium. The level of detection for mercury was greater than the established EPA criteria for both chemical laboratories used. However, no mercury was detected by either lab in the elutriates of the dredge, reference, and disposal site sediments. Mercury was detected, in three water samples, two from the disposal site and one from the reference site (Table 4). Cadmium in the elutriate of the dredge material was below EPA criteria. The level of detection for cadmium in the disposal site sediments exceeded EPA criteria. The SWRCB's criteria is less conservative than EPA's and mercury and cadmium levels in dredge site sediments were far below the criteria. Copper, zinc, lead, phenol, and total chlorinated pesticides and PCB's were well below SWRCB's criteria in the elutriate of the dredge material and in the disposal site water analyzed in January 1979. Detection limits for water and sediment samples taken in June at the disposal site were greater than the SWRCB's criteria for those constituents.

EPA has specified that when no criteria is established, levels of the constituent in the water column should not exceed 0.01 of the lowest continuous flow 96-hour LC_{50} to several important freshwater or marine species. This criteria was applied during the bioassay. Since there were no mortalities in any phase bioassay greater than 24%, a lethal concentration at which 50 percent of the population dies (LC_{50}) could not be determined.

b. Consider mixing zone. Results of mixing calculations are based on the release zone method as described in the Implementation Manual for Section 103 of MPRSA (P.L. 92-532) published jointly by the EPA and the Corps of Engineers.

This method assumes that at the end of a 4-hour initial mixing period, the liquid and suspended particulate phases of the dredge material are evenly distributed over a column of water bounded on the surface by a locus of points constantly 100 meters from the perimeter of the dumping barge, beginning at the first moment in which dumping commences and ending at the last moment (the release zone) and extending to the ocean floor, thermocline, halocline, or to a depth of 20 m, whichever is shallower. To calculate the initial mixing zone using the release zone method, the depth used was that of the thermocline/halocline (10 m). The mode of discharge was assumed to be a moving barge. The barge used in the calculation is 60.9 m long by 13.7 m wide and moving at a speed of 0.15 m /sec. It takes 600 sec. for such a barge to release all of the dredged material. If a split hull barge is used the time for release would be about 300 sec.

The initial mixing zone volume (Vm) for the Crescent City disposal site is 664,033 m^3. The volumes of the liquid phase (Vw) and suspended particulate phase (Vsp) were calculated to be 1,578 m^3 and 717 m^3, respectively. Bioassays were conducted with the liquid phase in which organisms were exposed to various dilutions, expressed in percent of original liquid phase concentration. Since the results of the bioassays must be examined in light of initial mixing, it is necessary that the dilution expected at the disposal site after initial mixing also be expressed in percent of original phase concentration. This was calculated to be 0.24% for the liquid phase (Cw) and 0.11% for the suspended particulate phase (Csp).

c. Based on "a" and "b" above will the disposal operations be compatible with applicable standards? Yes, all applicable standards will be met. Where there are no standards, the LPC or limiting permissible concentration (the concentration that, after initial mixing, will not exceed a toxicity threshold of 0.01 of the acutely toxic concentration) must be determined.

To predict if dredged material concentrations exceed the LPC, it must be determined if Cw, as reported above, is higher than 0.01 of the acutely toxic concentration found in the bioassays. Since survival was not less than 50 percent in any test concentration, lethal concentrations at which 50 percent of the test organisms die (LC_{50} values) could not be calculated. Therefore even without mixing or dilution, the water quality standards are not exceeded.

The LPC of the suspended particulate and solid phases of a material means that concentration which will not cause unreasonable acute or chronic toxicity or other sublethal effects based on bioassay results (40 CFR 227.27). Since the 100 percent suspended particulate phase and the solid phase did not cause significant mortalities, an LPC could not be determined.

Based on the results of the bioassays, examined in light of initial mixing, the disposal operation is determined to be compatible with applicable standards.

6. Selection of Discharge Sites for Dredged or Fill material

a. Need for proposed activity. Barge shipments of petroleum products dominate the current commerce of Crescent City Harbor. The barge operation pattern is highly inefficient and on the average requires that 42% of the total shipment be offloaded in other ports due to the shallow harbor depths. Petroleum products barged from San Francisco offload about 40%

at Eureka or about 55% at Coos Bay. Harbor deepening would eliminate the need for offloading and reduce tidal delays.

b. Alternative sites and methods of discharge. The Crescent City Harbor District (the local sponsor) has determined that no land sites are adequate or economically feasible for containment of the dredge material. Beach disposal is not a recommended alternative since the material is not compatible with the beach sediments. Ocean disposal is the only remaining disposal alternative available or feasible.

The 100 fm ocean disposal site that has been EPA interim designated is not environmentally more acceptable than the proposed site. It is, however, more costly and would not result in positive net benefits for the project. No other EPA interim designated sites are located in the Crescent City harbor Area.

Hydraulic removal of dredge material is not feasible due to the lack of land disposal sites. Although the entrance channel has been maintained by hopper dredge, it is not possible to get a hopper dredge into the harbor for sediment removal due to the shallow water condition. No other methods of discharge are available.

c. Considerations in discharge determinations. Effect upon chemical, physical and biological integrity of the marine ecosystem: food chain; diversity of species; movement into and out of feeding, spawning, breeding and nursery areas; wetland areas; threatened or endangered species; and aesthetic, recreational, and economic values are all expected to be minimal.

d. Impacts upon the following water uses at the proposed site are expected to be minimal or non-existent:

(1) No municipal water supply intakes are located at or near the proposed ocean disposal site.

(2) No areas of concentrated shellfish production are located in or near the proposed site.

(3) Every effort will be made to schedule disposal operations to avoid peak seasonal imgration of marine life.

(4) No adverse effect upon wildlife at the site is expected.

(5) Recreational fishing by individuals may be disrupted temporarily during disposal. However, the areas available to fishermen are large compared to the disposal site.

(6) No threatened or endangered species are expected to be impacted at the site.

(7) Impacts on benthos are expected to be minimal, short-term, and limited to within the disposal site boundaries.

(8) No wetlands are situated in or near the disposal site; none would be impacted by dispersion of dredged material.

(9) No submerged vegetation is known at the site.

(10) No coastal or estuarine areas are expectd to be impacted by the disposal at this site.

(11) The size of the site was specified in the Ocean Dumping Regulations (40 CFR 228.12) and based on the initial mixing calculations appears adequate for dredge material disposal from Crescent City navigation channel.

e. Considerations to minimize effects:

(1) Water quality criteria. Dredge material was evaluated using both the State Water Resources Control Board's criteria and EPA's criteria.

(2) Alternatives to open water disposal were evaluated. No land sites are available or adequate. Dredge material is incompatible with beach sediments.

(3) The physical characteristics at the open ocean disposal site offer greater potential for dilution of the dredge material than a site inside the harbor.

(4) Ocean dumping is the proposed disposal method.

(5) The proposed dredge material does not appear to be contaminated, particularly in light of dilution and initial mixing.

(6) Confined disposal is not applicable to this project.

(7) Monitoring at the disposal site shall be coordinated with EPA upon preparation of the final EIS for the project.

(8) Dredge and disposal operations shall cease in January through March to accommodate herring spawning in the harbor.

7. <u>Conclusions and Determinations</u>

a. An ecological evaluation has been made following the evaluation guidance to 40 CFR 230.4 in conjunction with the evaluation considerations in 40 CFR 230.5.

b. A technical evaluation has been made following the criteria for evaluating environemental impact in 40 CFR 227.4-6, 227.9, 227.10, and 227.13 in conjunction with the evaluation considerations in 40 CFR Sub-parts C, D, E, and G.

c. Appropriate measures have been identified and incorporated in the proposed plan to minimize adverse effects on the aquatic environment as a result of the discharge.

d. Consideration has been given to the need for the proposed activity, the availability of alternate sites and methods of disposal that are less damaging to the environment, and suchd water qualilty standards as are appropriate and applicable by law.

e. Ocean disposal of the dredge material at the proposed site would not adversely impact wetlands.

f. The proposed disposal would not unduly degrade or endanger the marine environment and the disposal would present:

(1) No unacceptable adverse effect on human health and no significant damage to the resources of the marine environment;

(2) No unacceptable adverse effect on the marine ecosystem;

(3) No unacceptable adverse persistent or permanent effects due to dumping of the particular volumes or concentrations of these materials; and

(4) No unacceptable adverse effect on the ocean for other uses as a result of direct environmental impact.

<u>FINDINGS</u>

After making the above required determinations, the discharge site for Crescent City navigation Project has been selected according to Section 404 (b) and 103 (b) guidellnes. By letter dated 9 may 1980, the California Regional Water Qualilty Control Board-North Coast Region hss approved of the porposed discharge by waiving the certification requirements. No dredged material shall be removed and sold for profit. No permit from the State Lands Commission would be required.

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD—
NORTH COAST REGION

1000 CODDINGTOWN CENTER
SANTA ROSA, CALIFORNIA 95401
Phone: 707—545-2620

May 9, 1980

Department of the Army
Corps of Engineers
211 Main Street
San Francisco, CA 94105

Attention Karen Daniels

Gentlemen:

Subject: Crescent City Harbor Navagation Project

In regard to the subject project, we received a technical evaluation prepared by Ecological Analyst, Inc., and a Section 404(b) evaluation prepared by the U.S. Army Corps of Engineers. After review of these documents, we find that the project will result in a discharge to navigable waters, however, it will conform to water quality standards.

By copy of this letter, we will recommend to the State Water Resources Control Board the certification be waived. Thank you for the opportunity to comment on this project.

Sincerely,

Thomas B Dunbar

for David C. Joseph
Executive Officer

cc: State Board
Legal Division

CRESCENT CITY HARBOR

ANALYSIS OF SEDIMENTS

March 1979

AUTHORIZATION

1. Results of tests reported herein were requested by DA Form 2544, No. E86-79-3028, dated 27 February 1979, from the San Francisco District.

PURPOSE

2. The purpose of this study was to determine the amount of specified pollutants which were added to the dredge site water through the standard elutriate test and to determine the grain-size distribution of the sediments.

SAMPLES

3. Five sediment samples in plastic tubes and dredge site water in cubitainers were received 1 February 1979.

TEST METHODS

4. a. Standard Elutriate. Total petroleum hydrocarbons, pesticide, persistant organohalogens, copper, mercury, cadmium, lead, zinc, phenols, oil and grease, and residual hydrocarbons were run according to "Ecological Evaluation of Proposed Discharge of Dredge Material into Ocean Waters," by EPA/Corps of Engineers.

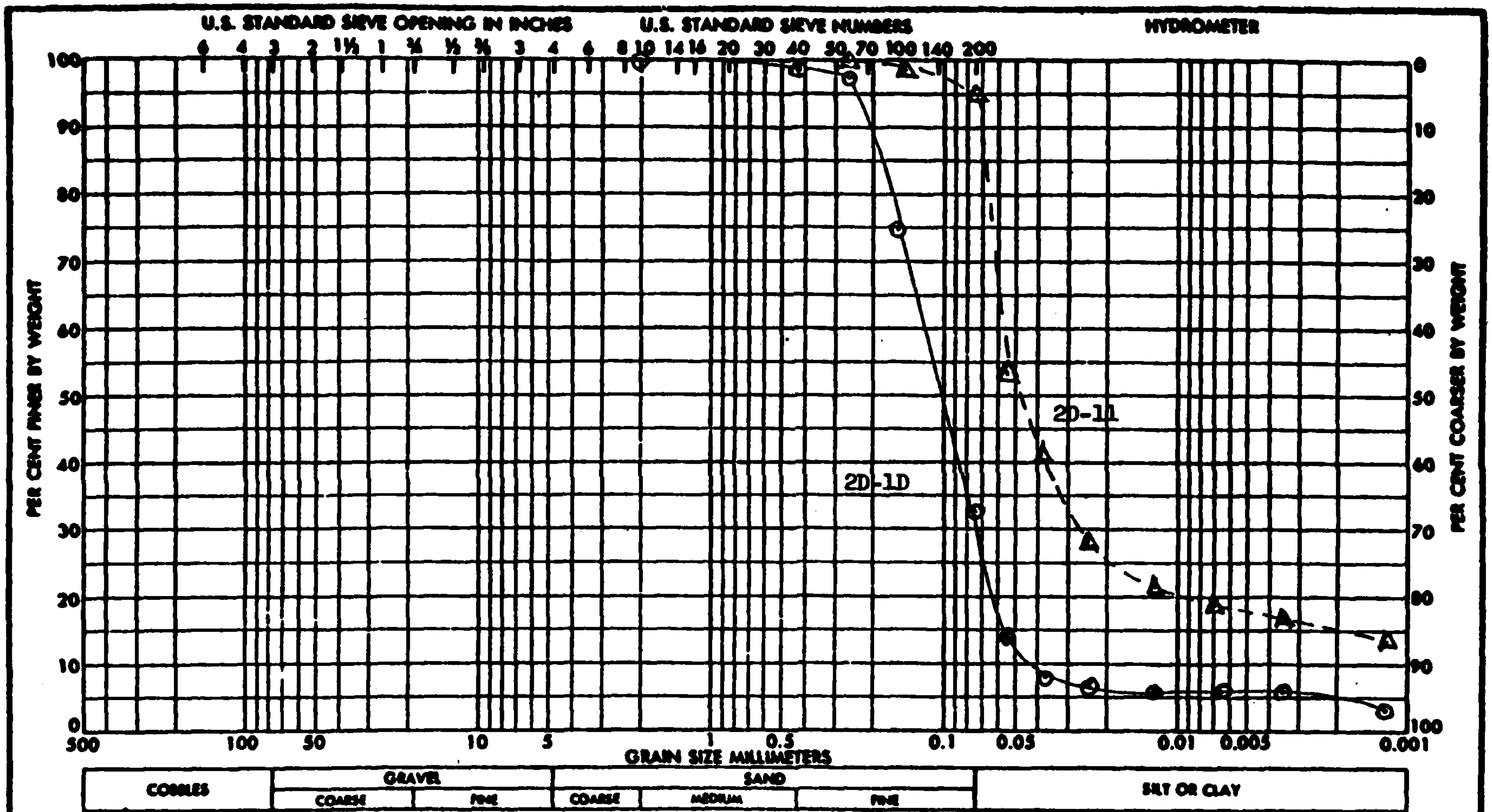
b. Particle size, Engineer Manual EM 1110-2-1906.

TEST RESULTS

5. Data are presented as follows:

a. Eng Form 2087 shows the gradation curves of the samples.

b. Tables 1 and 2 show the analysis of the samples.



SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
2D-1[illegible]		95% [illegible]				
[illegible]		33% [illegible]				

GRADATION CURVES

PROJECT: CRESCENT CITY HARBOR

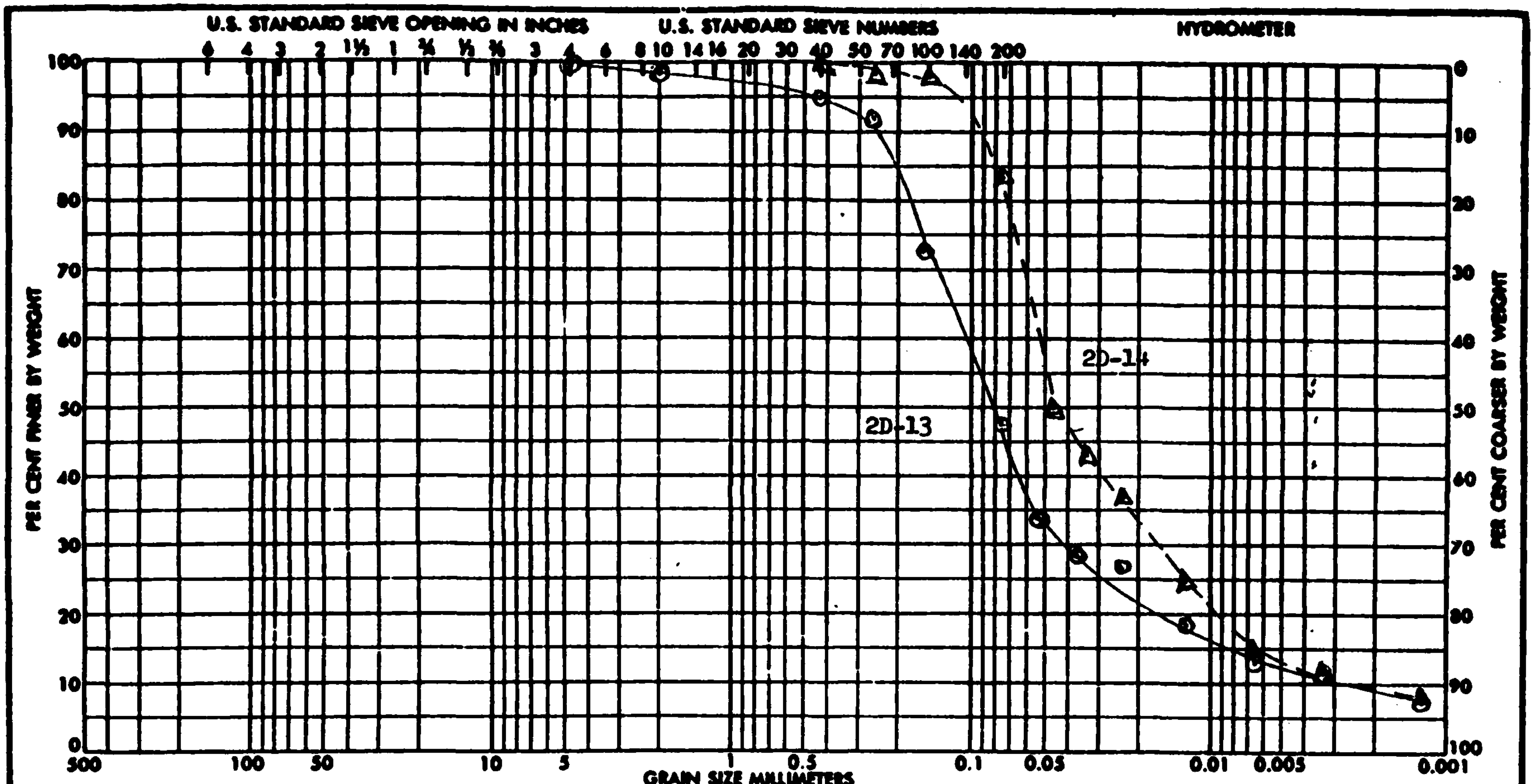
AREA:

BORING NO.: 2D-10 & 2D-11

DATE: March 1979

ENG FORM 1 MAY 63 **2087** REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

U.S. GOVERNMENT PRINTING OFFICE : 1963 O—[illegible]



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	ELEV OR DEPTH	CLASSIFICATION	NAT W%	LL	PL	PI
1		84% silt				
[illegible]		[illegible]				

GRADATION CURVES

PROJECT	CRESCENT CITY HARBOR
AREA	
BORING NO.	2D-13 & 2D-14
DATE	March 1979

ENG FORM 1 MAY 63 **2087** REPLACES WES FORM NO. 1241, SEP 1962, WHICH IS OBSOLETE.

U.S. GOVERNMENT PRINTING OFFICE : 1963 OF—703-186

TABLE 1

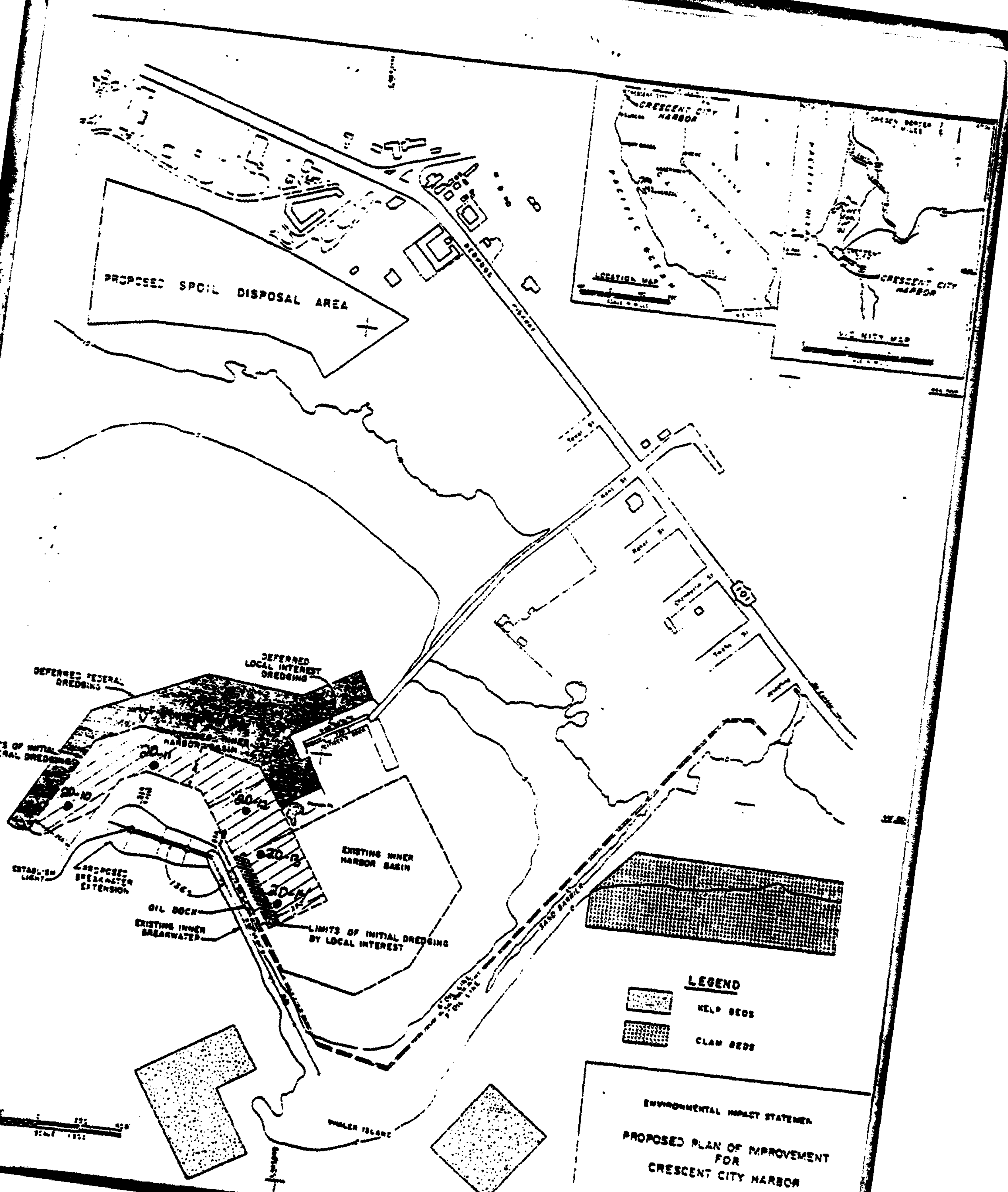
CRESCENT CITY HARBOR

Location	2D-10	2D-11	2D-12	2D-13	2D-14
Reported as mg/liter					
Mercury	0.0005-	0.0005-	0.0005-	0.0005-	0.0005-
Cadmium	0.001	0.001-	0.001-	0.001-	0.001-
Copper	0.001-	0.001-	0.001-	0.005	0.002
Zinc	0.020	0.010	0.010-	0.010-	0.010
Lead	0.004-	0.004-	0.004-	0.004-	0.004-
Oil and Grease	1-	1-	1-	2	2
Residual Petroleum Hydrocarbons	1-	1-	1-	1-	1-
Phenol	0.002	0.004	0.002	0.001	0.001
Reported as Micrograms/liter					
Persistent Organohalogens	0.03	0.05	0.10	0.25	0.30
Pesticides other that the Organohalogens	0.01-	0.01-	0.01-	0.01-	0.01-

TABLE 2

CRESCENT CITY HARBOR

Location	DR	DIS-1	DIS-3	DIS-5	DIS REF
Reported as mg/liter					
Mercury	0.0006	0.0005	0.0005-	0.0005-	0.0005
Cadmium	0.002	0.001	0.001	0.001-	0.001
Copper	0.003	0.005	0.001-	0.001-	0.002
Zinc	0.010-	0.010-	0.010-	0.010-	0.010-
Lead	0.004-	0.004-	0.004-	0.004-	0.004-
Oil and Grease	1	2	2	2	1
Residual Petroleum Hydrocarbons	1-	1-	1-	1-	1-
Phenol	0.002	0.002	0.002	0.001-	0.002
Reported as Micrograms/liter					
Persistent Organohalogens	0.10	0.10	0.09	0.05	0.10
Pesticides other than the Organohalogens	0.01-	0.01-	0.01-	0.01-	0.01-


PROPOSED SPOIL DISPOSAL AREA
CRESCENT CITY HARBOR
LOCATION MAP
CRESCENT CITY HARBOR
VICINITY MAP
DEFERRED FEDERAL DREDGING
DEFERRED LOCAL INTEREST DREDGING
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LEGEND
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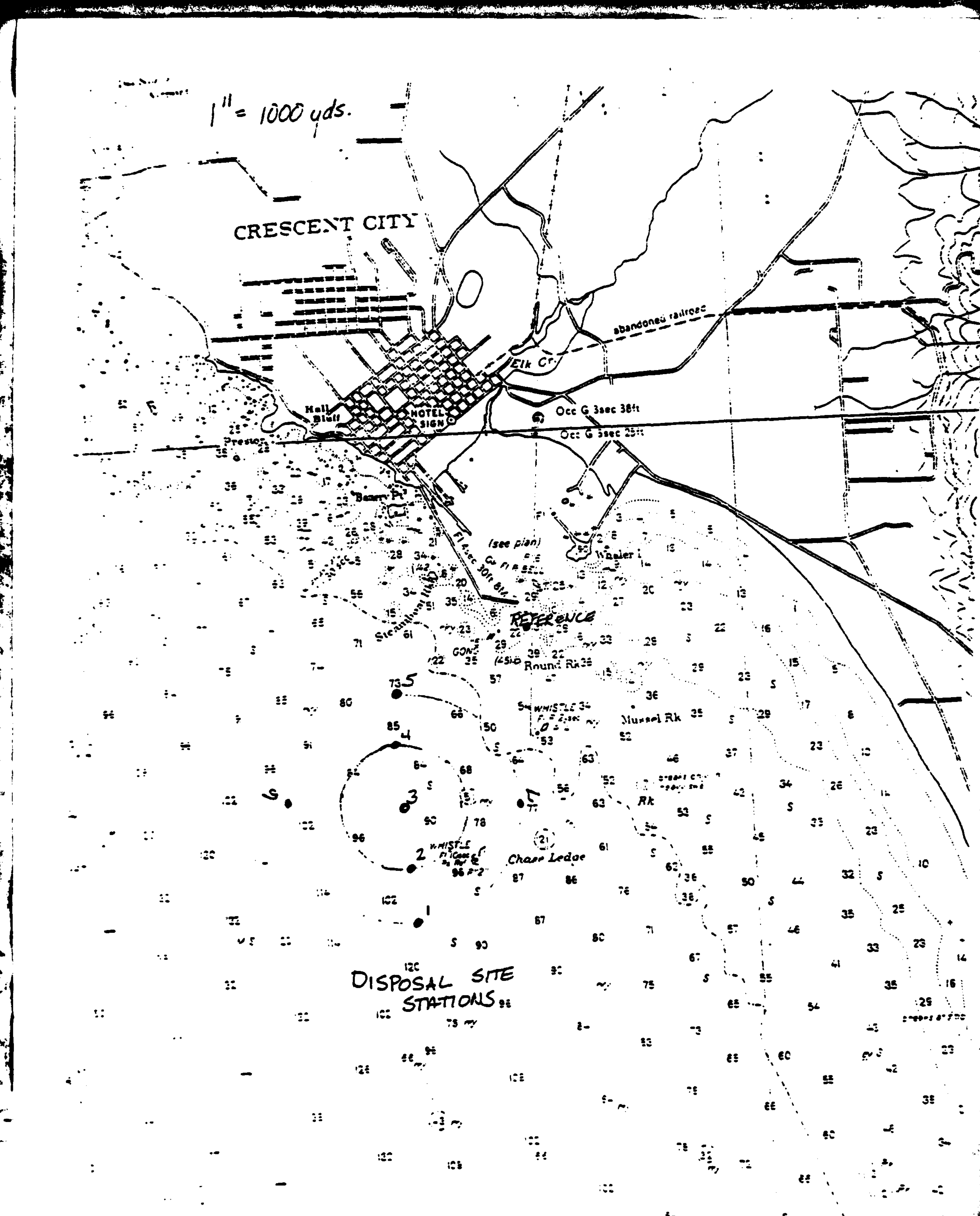
CLAM BEDS
ENVIRONMENTAL IMPACT STATEMENT
PROPOSED PLAN OF IMPROVEMENT FOR CRESCENT CITY HARBOR
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO CORPS OF ENGINEERS



1" = 1000 yds.
CRESCENT CITY
abandoned railroad
Elk Cr.
Hall Bluff
HOTEL SIGN
Occ G 3sec 38ft
Occ G 3sec 25ft
Preston
Battery Pt
(see plan)
Whaler I
REFERENCE
Round Rk
Mussel Rk
Chase Ledge
1
2
3
4
5
DISPOSAL SITE STATIONS

SIERRA CLUB
Redwood Chapter
North Group
POST OFFICE BOX 238
ARCATA, CALIFORNIA 95521

February 22, 1980

Colonel John M. Adsit
District Engineer
U.S. Corps of Engineers
San Francisco District
211 Main Street
San Francisco, CA 94105

Re: Public Notice
404 Evaluation Report
Crescent City Harbor

Dear Sir:

In regard to Public Notice - 404 Evaluation Report, Crescent City Harbor, the North Group eagerly awaits a supplemental Environmental Statement being prepared by your office, as indicated.

At present we question the need for proposed expansion and could only guardedly accept the proposed ocean disposal site as preferable to shoreline dumping or wetlands filling.

Although little effect to the benthic community is anticipated at this time, we also question the long term effect if ocean disposal continues over a many years period of maintenance dredging.

As the proposed project is only one segment of a greater and more far reaching expansion program, we will continue to closely monitor all developments.

Thank you for all information available.

Sincerely,

NORTH GROUP EXECUTIVE COMMITTEE

by: Lucille Vinyard

Lucille Vinyard, Secretary

STATE OF CALIFORNIA—STATE LANDS COMMISSION EDMUND G. BROWN JR., Governor

STATE LANDS COMMISSION
17 13TH STREET
SACRAMENTO, CALIFORNIA 95814

February 25, 1980

File: SD 80-1-20

Col. John M. Adsit
U.S. Army Corps of Engineers
San Francisco District
211 Main Street
San Francisco, CA 94105

Dear Col. Adsit:

The staff of the State Lands Commission has received Public Notice - 404 Evaluation Report, dated January 25, 1980, relative to your proposed dredging of the Crescent City Inner Harbor Basin adjacent to the existing inner breakwater in Del Norte County.

This is to advise that this Commission has no objection to the project providing none of the excavated material is sold for commercial purposes or is removed from the lands which have been granted in trust to the Crescent City Harbor District pursuant to Chapter 1510, Statutes of 1963, with minerals reserved to the State of California.

If any of the material is removed from the granted area, a permit will be required from the State Lands Commission.

Very truly yours,

Judy Lewandowski

JUDY LEWANDOWSKI
Public Notice Coordinator
(916) 322-1219

JL/ma

cc: Mr. Bob Belcher
Harbor Master
Crescent City Harbor District
P.O. Box 606
Crescent City 95531

APPENDIX B

EA Report ACE91A

A TECHNICAL EVALUATION OF POTENTIAL ENVIRONMENTAL IMPACTS OF PROPOSED OCEAN DISPOSAL OF DREDGED MATERIAL AT CRESCENT CITY HARBOR, DEL NORTE COUNTY, CALIFORNIA

Prepared for

Department of the Army
San Francisco District
Corps of Engineers
211 Main Street
San Francisco, CA 94105

Prepared by

Ecological Analysts, Inc.
2150 John Glenn Drive
Concord, CA 94520

January 1980

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EXECUTIVE SUMMARY

Ecological Analysts, Inc. (EA) was contracted by the U.S. Army Corps of Engineers, San Francisco District, to conduct a study which was designed to assess the potential for impact on marine organisms due to the proposed ocean disposal of dredge material from Crescent City Harbor, California. The study was conducted from June to September 1979 and required: (1) a field survey to identify the resident marine community and the oceanographic parameters (currents, water quality profiles, and chemical characteristics) existing in the vicinity of the proposed disposal site; (2) an assessment of the response of selected marine organisms to various concentrations and phases of dredge material in static and flow-through bioassay tests; and (3) a study of the bioaccumulation potential of chemical constituents from the dredge material.

A sharp thermocline between 8 and 12 m and a less distinct halocline between 6 and 10 m was found at the disposal site. Current speeds averaging 23.9 cm/sec at the surface decreased to an average of 3.7 cm/sec near the bottom. Although current direction was highly variable, the major water flow was in a northerly direction.

Chemical analyses of water and sediment samples at the proposed disposal site revealed trace amounts of mercury (3 and 5 ppb) at two surface water stations and phenol concentrations of 5 ppb in two sediment samples. Sediments were characterized as medium- and fine-grained sands, with the majority of particle sizes between 75 and 500 μm.

Phytoplankton abundance, as measured by chlorophyll levels, averaged 6.6 mg/m^3 in samples collected during the day and was slightly higher in samples collected at night. Over 5,300 organisms from 127 different taxa were collected in benthic samples, with the polychaete Owenia collaris and the gastropod Olivella pycna being found in greatest abundance. Over 65 different taxa were collected in the zooplankton tows and were dominated by the copepods Calanus pacificus and Pseudocalanus elongatus. Over 17,000 organisms representing 38 taxa were collected in epibenthic otter trawls; most abundant were Dungeness crab (Cancer magister), Pacific tomcod (Microgadus proximus), and night smelt (Spirinchus starksi).

After consultation with the Army Corps of Engineers, San Francisco District; the Environmental Protection Agency, Region IX; the California Department of Fish and Game; and the U.S. Fish and Wildlife Service following the field survey, appropriate sensitive marine organisms were selected for bioassay testing to determine if proposed ocean disposal of dredge material would adversely affect survival. Speckled sanddab (Citharichthys stigmaeus), Dungeness crab (Cancer magister), and the copepod Calanus pacificus were tested in liquid and suspended phase static bioassays. The polychaete Nephtys caecoides and the gastropod Olivella biplicata were tested in solid phase flow-through bioassays. The sea cucumber Eupentacta quinquesemita was used in both solid phase bioassays and bioaccumulation tests.

There were no significant differences in survival between the control treatment and the 100 percent dredge material treatment for any species tested in

liquid, suspended, and solid phase bioassay tests. There was no significant bioaccumulation of chemical contaminants in the tissues of sea cucumbers held for 10 days in a flow-through 100 percent dredge material treatment.

1. INTRODUCTION

1.1 BACKGROUND

This study was conducted in fulfillment of Section 103 of Public Law 92-532 (Marine Protection, Research and Sanctuaries Act of 1972) which requires evaluation of the ocean disposal of dredge material to determine the potential for impact of such disposal on the marine environment. Regulations describing the criteria to be applied pursuant to P.L. 92-532 were published by the Environmental Protection Agency (EPA) in the 11 January 1977 Federal Register (Vol. 42, No. 7 and later appearing in the Code of Federal Regulations [Title 40, parts 220-229; hereafter referred to as 40 CFR]). In accordance with 40 CFR 227.27(b), the EPA and the CE developed a methodology for assessing the potential for impact of ocean disposal of dredge material in the manual "Ecological Evaluation of Proposed Discharge of Dredged Material into Ocean Waters" (hereafter referred to as the Manual).

The Crescent City Navigation Project, Del Norte County, California, was authorized for construction in 1965. Since the dredge material did not meet the conditions for exclusion of 40 CFR 227.13(b), the CE determined that a technical evaluation, including a field survey of the proposed disposal site, was required for the environmental impact statement. On 29 May 1979 the CE contracted Ecological Analysts, Inc. (EA) to conduct a study to determine the potential for impact of the ocean disposal of dredge material from Crescent City Harbor, California (Contract No. DACW07-79-C-0048).

The ocean disposal of dredge material may affect the marine biological community through the release of chemical constituents associated with the dredge material and/or through the disruption of organismal processes due to the physical presence of suspended and settled solids. To assess this potential for impact, organisms representative of species found in the vicinity of the disposal site are tested in bioassays that simulate disposal conditions at or outside the site boundaries. The results of the bioassay tests are evaluated by the CE to determine the suitability of dredge material disposal in the ocean.

1.2 STUDY SCOPE AND OBJECTIVES

Since there was no available information on the disposal site, a field survey was conducted prior to initiation of the bioassay tests.

The field survey was designed to: (1) characterize the resident marine community and identify any potentially sensitive species located near the proposed disposal site; (2) describe the physical parameters (currents, thermoclines, water quality profiles) existing in the disposal area; (3) identify any background levels of chemical contaminants in the seawater and sediments near the proposed disposal site and at potential reference sites; and (4) locate a reference site suitable for supplying water and sediments to be used in bioassay testing. The CE, San Francisco District, developed a study plan (see Scope of Services—Appendix A) based on the Register which outlined the location, timing, and number of physical, chemical, and biological samples to be collected.

The bioassays were designed to examine the response of selected appropriate sensitive organisms to laboratory simulated conditions that could occur during dredge disposal operations. Conditions at the disposal site were simulated through the testing of three states of dredge material--liquid, suspended, and solid phases. Bioassay testing of the liquid phase (the supernatant from a mixture of dredge material and reference site water filtered through a 0.45-µm filter) was designed to evaluate the potential for impact of dissolved chemical contaminants released from the sediment during disposal operations. Bioassay testing of the suspended phase (the unfiltered supernatant from a mixture of dredge material and reference site water) was designed to evaluate the potential for impact on organisms due to both the physical presence of suspended particles in the water and to any biologically active components associated with them. Testing of the solid phase (undiluted dredge material released on top of benthic organisms held in reference sediment) was designed to evaluate the potential for impact of disposal operations on organisms found at and beyond the boundaries of the disposal site. A laboratory bioaccumulation study conducted in conjunction with the solid phase bioassay testing was designed to assess the potential for long-term accumulation of toxins in organismal tissues due to disposal operations. The methods used in the bioassay and bioaccumulation are those studies outlined in the Manual and the Scope of Services.

1.3 STUDY LOCATION

The study was conducted at dredge, disposal, and reference sites in and near Crescent City Harbor, California, which is on the Pacific coast about 27 km south of the California-Oregon border.

1.3.1 Dredge Site

The dredge site is located in Crescent City Harbor in an area adjacent to the northwest jetty off Whaler Island (Figure 1). The dredge material sampling sites for bioassay tests are shown as points A-E (discussed later in Section 3, Bioassays).

1.3.2 Disposal Site

The proposed disposal site is an EPA interim designated site at 124° 12' 00" west longitude and 41° 43' 15" north latitude on a 186° magnetic north heading, 2,100 m from the tip of the east jetty (Figure 2). The disposal site is 914 m in diameter and is located in approximately 27 m of water.

1.3.3 Reference Site

Following the field survey, a reference site was selected where the water and sediments were chemically and sedimentologically similar to the proposed disposal site (Figure 2). Water for all bioassays was pumped from the reference site into the mobile bioassay laboratory situated on the south jetty (Figure 1).

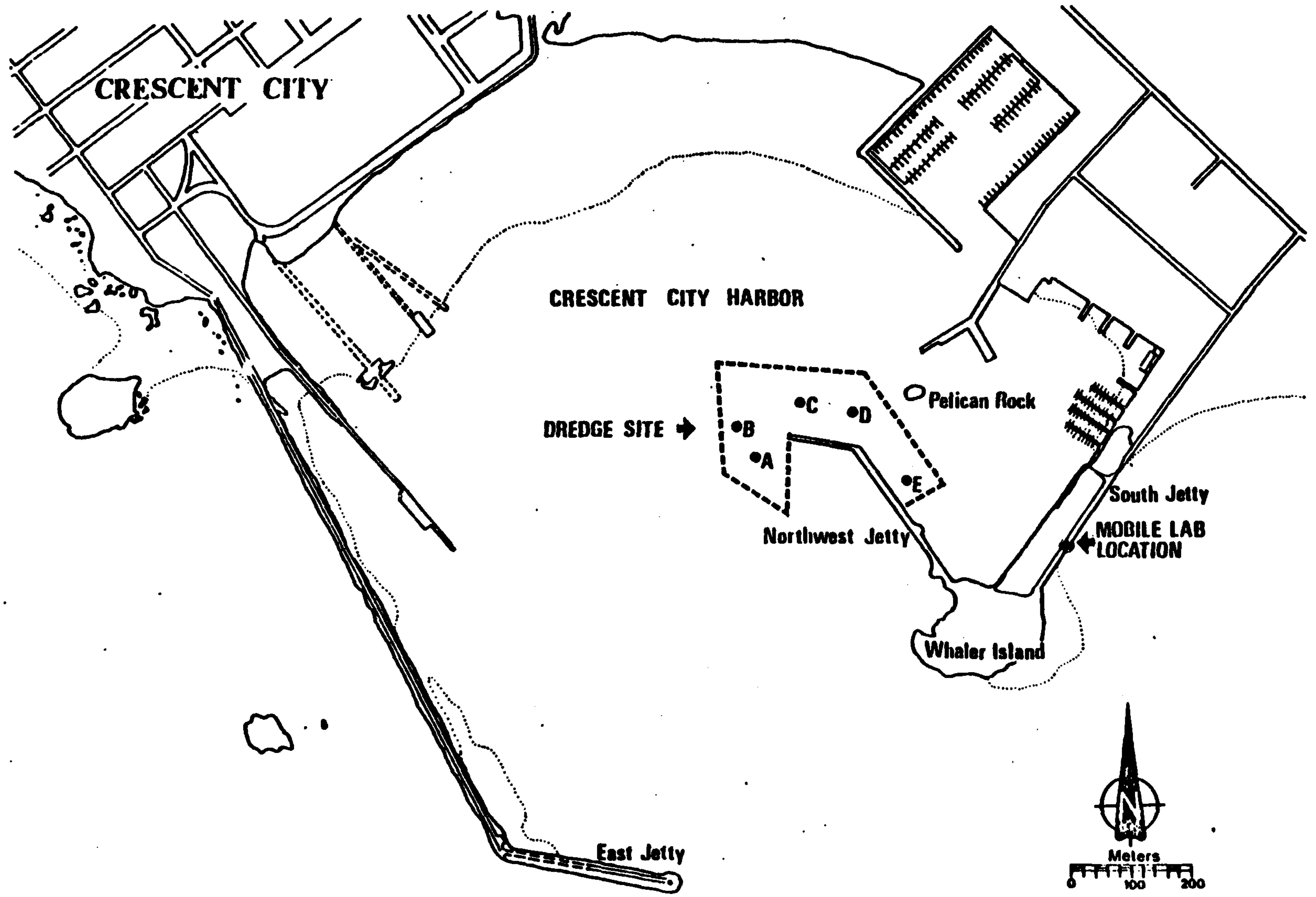

Figure 1. Dredge site and mobile laboratory locations in Crescent City Harbor, California. Points A-E are dredge material sampling sites for bioassay tests.

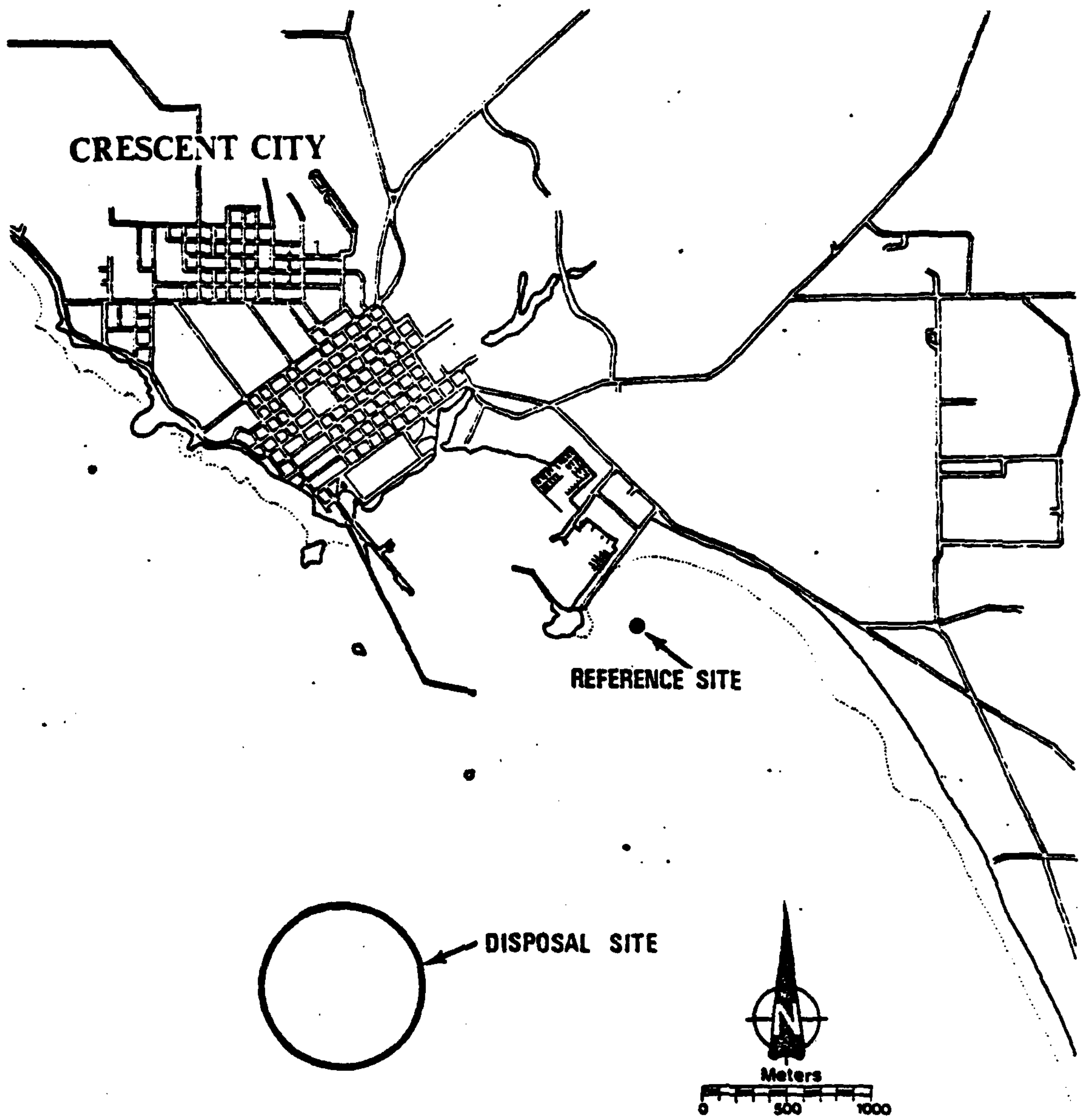

Figure 2. Proposed disposal and reference site locations near Crescent City Harbor, California.

2. FIELD SURVEY

2.1 INTRODUCTION

The initial phase of this project consisted of a field survey to characterize the physical, chemical, and biological environment of the proposed dredge disposal site. The purposes of the field survey were:

1. to determine the directions and speeds of currents;
2. to characterize the species composition and abundance of organisms living on or in the bottom sediments (benthos), drifting passively in the water column (plankton), or actively swimming in the water column (nekton), so that the general ecological condition of the proposed dredge disposal site could be evaluated;
3. to analyze sea water and sediment samples for potentially toxic heavy metals and organic compounds at and around the proposed disposal site;
4. to measure the general water quality parameters--temperature, dissolved oxygen, conductivity, pH, and turbidity--of the water column as a part of the general site characterization; and
5. to select a suitable reference site where physical and chemical characteristics of sediments were similar to those of the proposed disposal site which could be used as a control in the bioassay testing.

2.2 METHODS

The field studies to measure water quality parameters and currents, to collect plankton and benthos, and to select a reference site were conducted between 25 and 30 June 1979; fish and macroinvertebrates were collected between 15 and 20 July 1979.

Temperature and conductivity measurements were made at the center of the proposed disposal site (Station F, Figure 3) at 2-m depth intervals from the surface to the ocean floor (27 m) using a Martek Instruments Mark V Water Quality Monitoring System.

Current speed and direction measurements were made at Stations A-F (Figure 3) at surface, bottom, middepth, and center of the thermocline (determined to be 10 m from the surface from temperature measurements at Station F) using a Marsh-McBirney Model 527 Electromagnetic Current Meter. These measurements were made under conditions of 2 to 3 m swells. A single release of rhodamine B dye was made at the surface at Station F and followed for 15 minutes. The current direction at the disposal site center (335° N) was used to set the station locations for the subsequent chemical and biological studies.

Phytoplankton samples for chlorophyll analysis were collected at Stations 1, 3, 5, 6, and 7 (Figure 4) by pumping one liter of filtered (333-μm mesh) sea water from approximately one meter below the surface into glass containers which were in turn stored in the dark on ice. On shore, the samples were filtered through 0.45-μm Millipore filters and stored on ice.

Six benthic samples were taken at each of the seven stations (Figure 4) using an 0.1-m^2 Smith-McIntyre grab sampler. Organisms from five of the samples

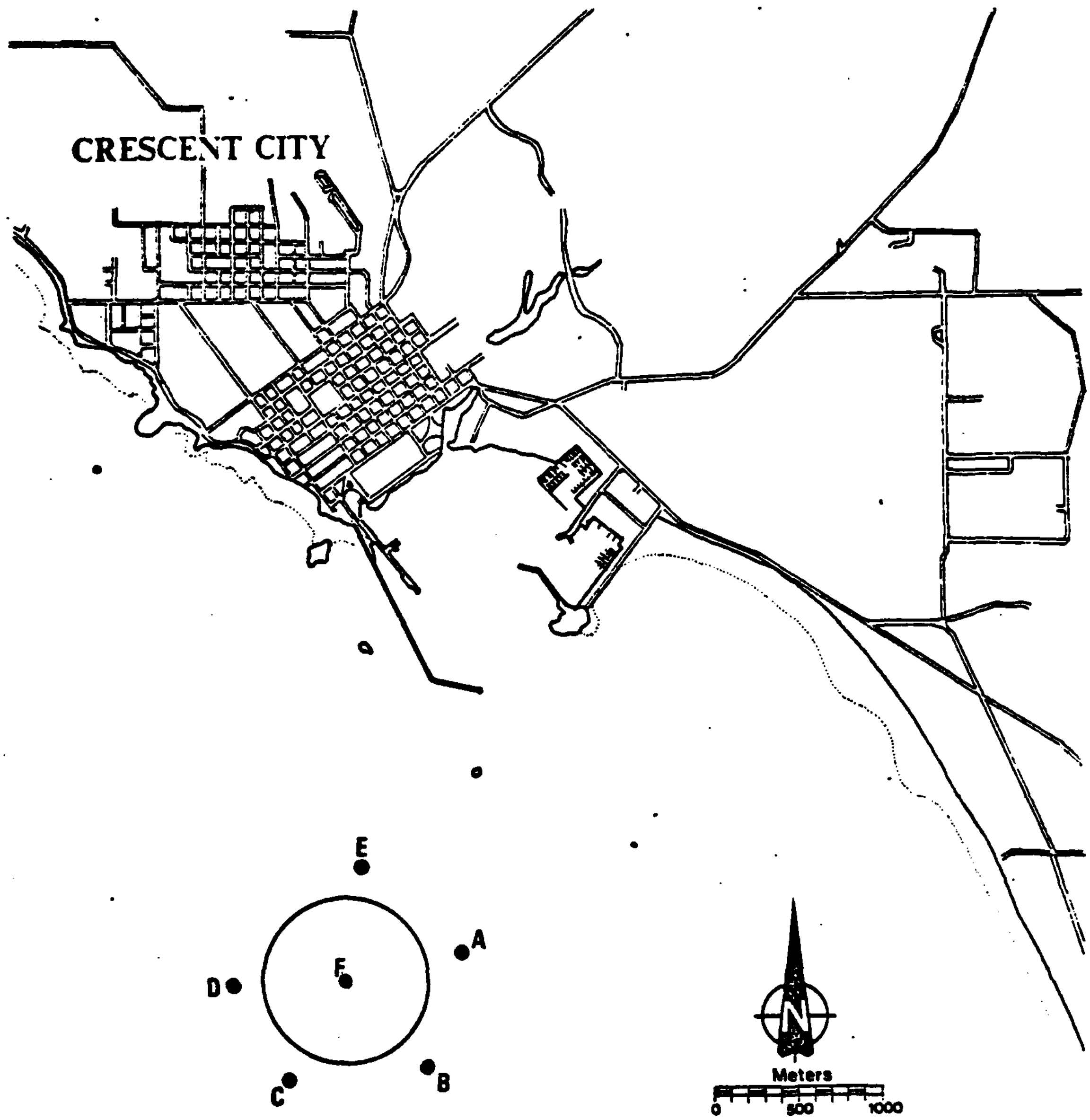

Figure 3. Station locations for current speed and direction samples near Crescent City Harbor, California, June 1979.

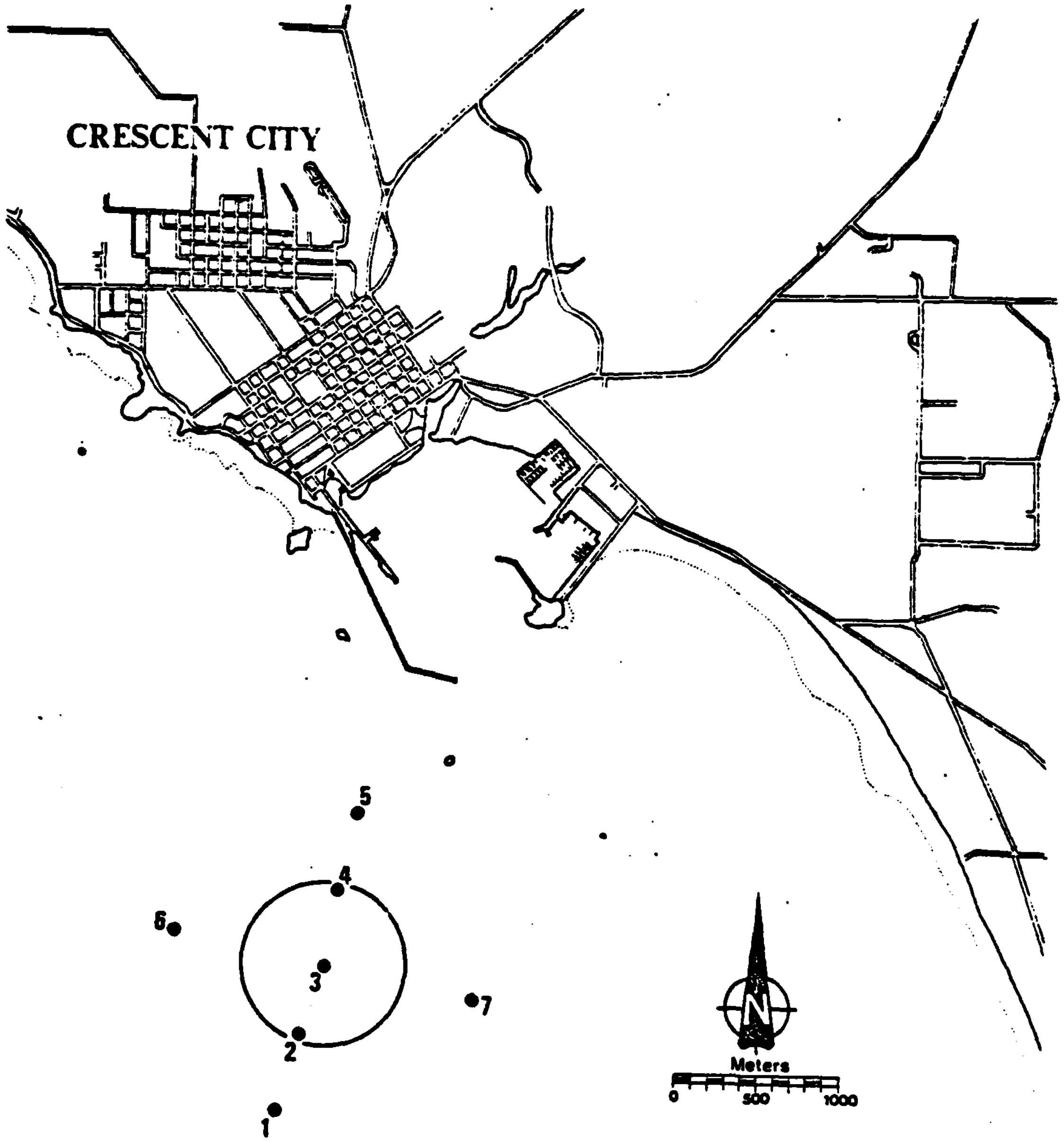

Figure 4. Station locations for phytoplankton, benthic, and water quality studies near Crescent City Harbor, California, June 1979.

per station (a total of 35 samples) were separated from the sediment in the field by sieving through a 1-mm mesh screen. All retained organisms were preserved with a 10 percent buffered formalin solution. The remaining sample from each station was split into two fractions; one fraction was preserved on ice for particle size analysis, and the other fraction was preserved on ice for chemical analysis. A single benthic grab sample was taken at each of six potential reference site stations (R1-R6, Figure 5) for particle size and chemical analysis.

Water samples for chemical analysis were collected one meter below the surface and one meter above the bottom at each of seven stations (Figure 4) using Beta Plus and Nanson water sampling bottles. In addition, measurements of temperature, conductivity, dissolved oxygen, and pH were taken at 3 m depth intervals at each station using the Martek system. Turbidity measurements were made onboard from water samples collected at 3 m intervals using a Turner Design Nephelometer.

Zooplankton were sampled day and night along 6 transects (Figure 6) using paired 0.5-m nets (333-µm mesh) mounted on rigid metal frames. After each tow, the nets were washed down with filtered sea water and samples were preserved in a 5 percent buffered formalin solution.

Fish and macroinvertebrates were sampled along 4 transects (Figure 7) day and night, using a 7.31-m otter trawl fitted with a 6-mm bar mesh at the codend. Tows were 5 minutes long and were conducted in both directions along each transect for a total of 16 tows. Fish and macroinvertebrates from the otter trawls were identified and enumerated onboard.

Zooplankton, benthic, and epibenthic macroinvertebrate organisms were identified and enumerated in Ecological Analysts' taxonomic laboratory, in Concord, California. Chlorophyll determinations were made by Anatec Laboratories, Dillon Beach, California. Total chlorophyll was determined by measuring the optical density of an acetone plankton concentrate using a spectrophotometer.

The chemical analyses of both seawater and sediment samples were performed by Ultrachem Corporation, Walnut Creek, California. Cadmium, lead, copper, and zinc were analyzed by direct flame atomic absorption spectrophotometry on samples preserved in nitric acid. Mercury was determined by cold vapor atomic absorption following acid-permanganate digestion. Phenol concentrations were determined colormetrically by the chloroform extraction method following distillation. Petroleum hydrocarbons were determined gravimetrically by freon extraction. Chlorinated hydrocarbons were extracted from the samples with dichloromethane/hexane, concentrated, and analyzed by gas chromatography using an electron capture detector. Sediment samples for particle size analysis were split, dried at 105 C, and analyzed using standard sieve sizes of 2,000, 850, 500, 150, and 75 µm and pan. Shaking time was five minutes, plus or minus five seconds.

2.3 RESULTS

There was a fairly sharp thermocline between 8 and 12 m and a less distinct halocline between 6 and 10 m at the disposal site center (Table 1). Temperature and conductivity remained relatively constant from 16 m to the bottom (26 m).

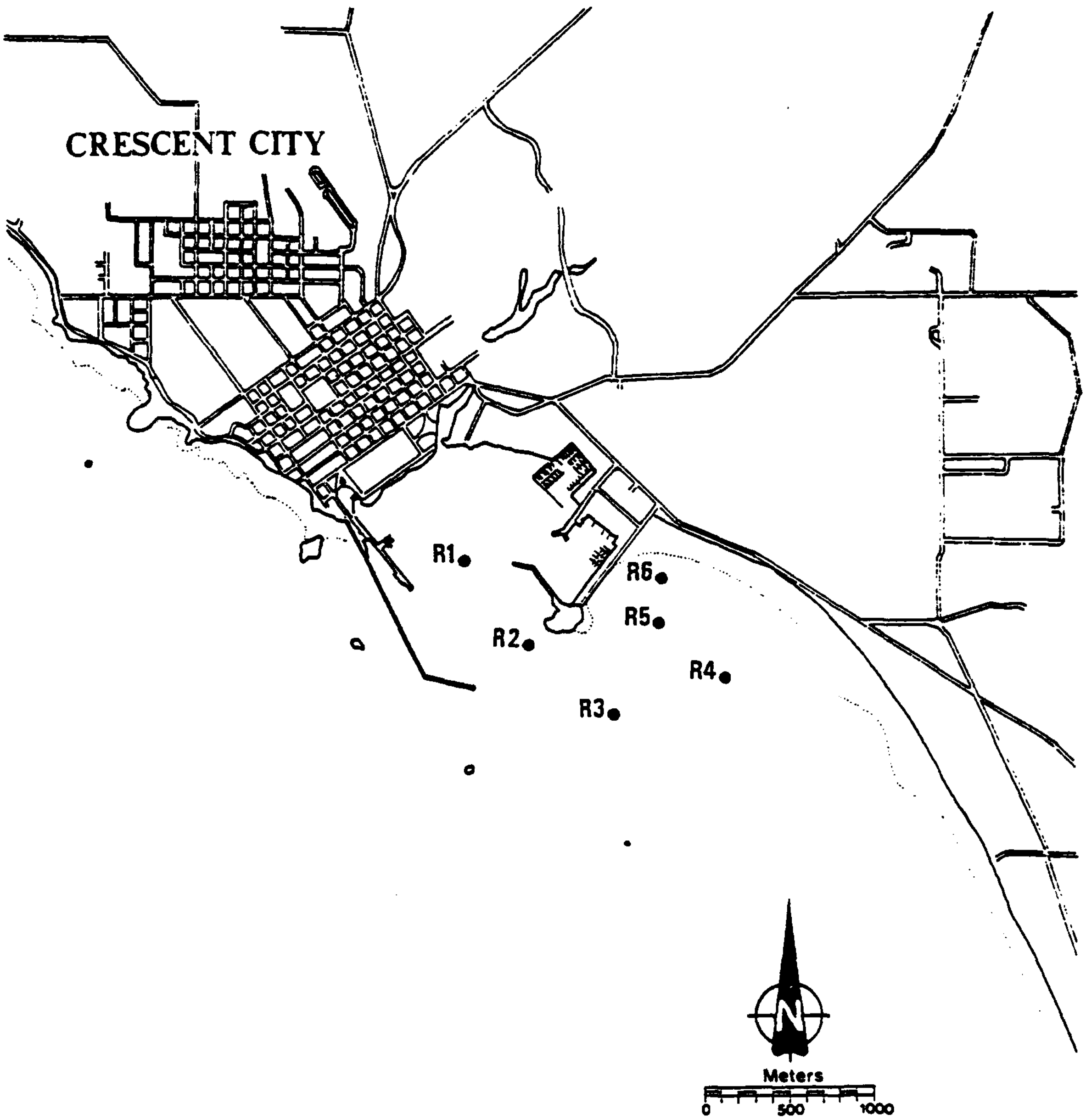

Figure 5. Station locations of six potential reference sites near Crescent City Harbor, California, June 1979.

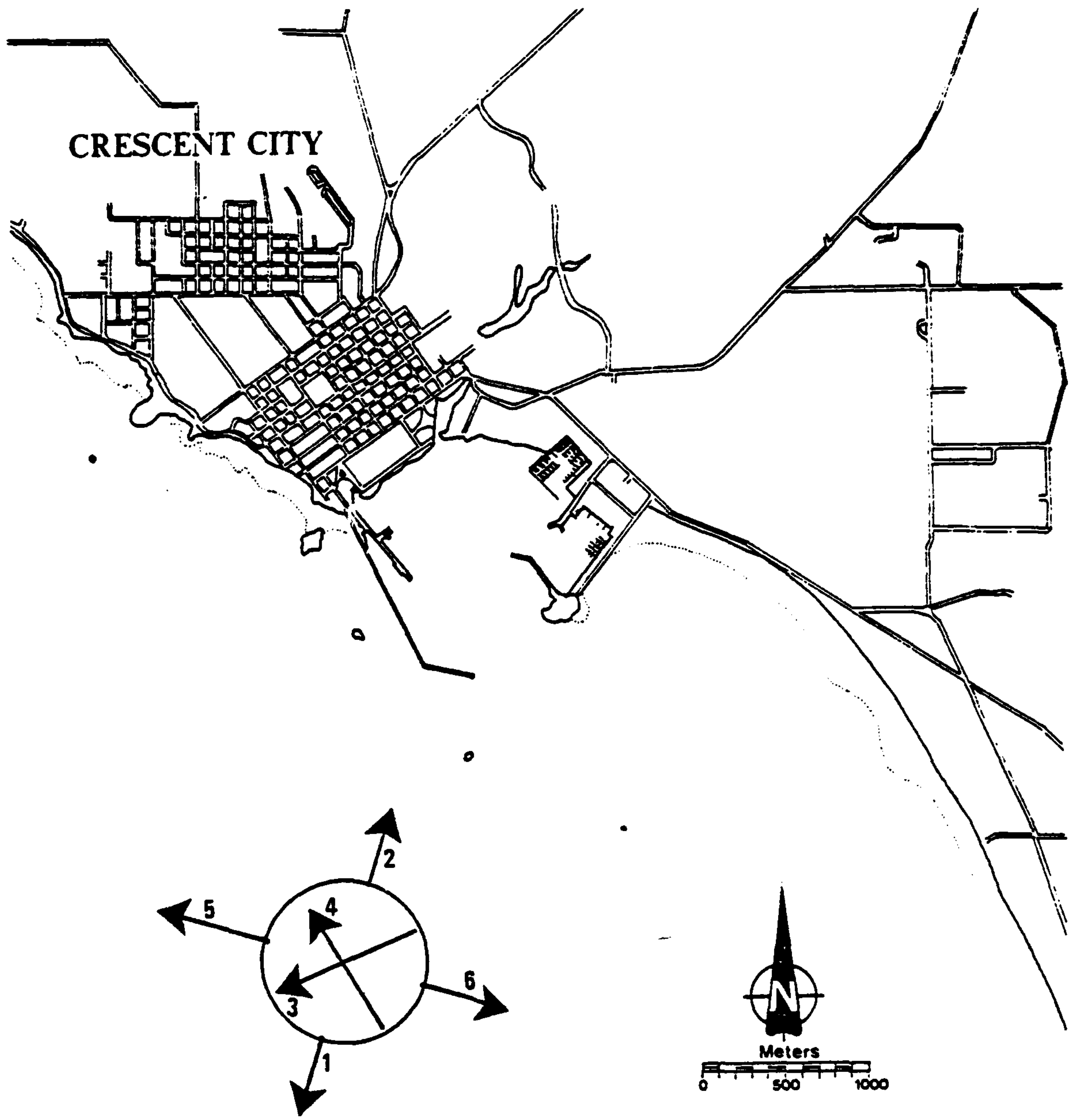

Figure 6. Transect locations for zooplankton tows near Crescent City Harbor, California, June 1979.

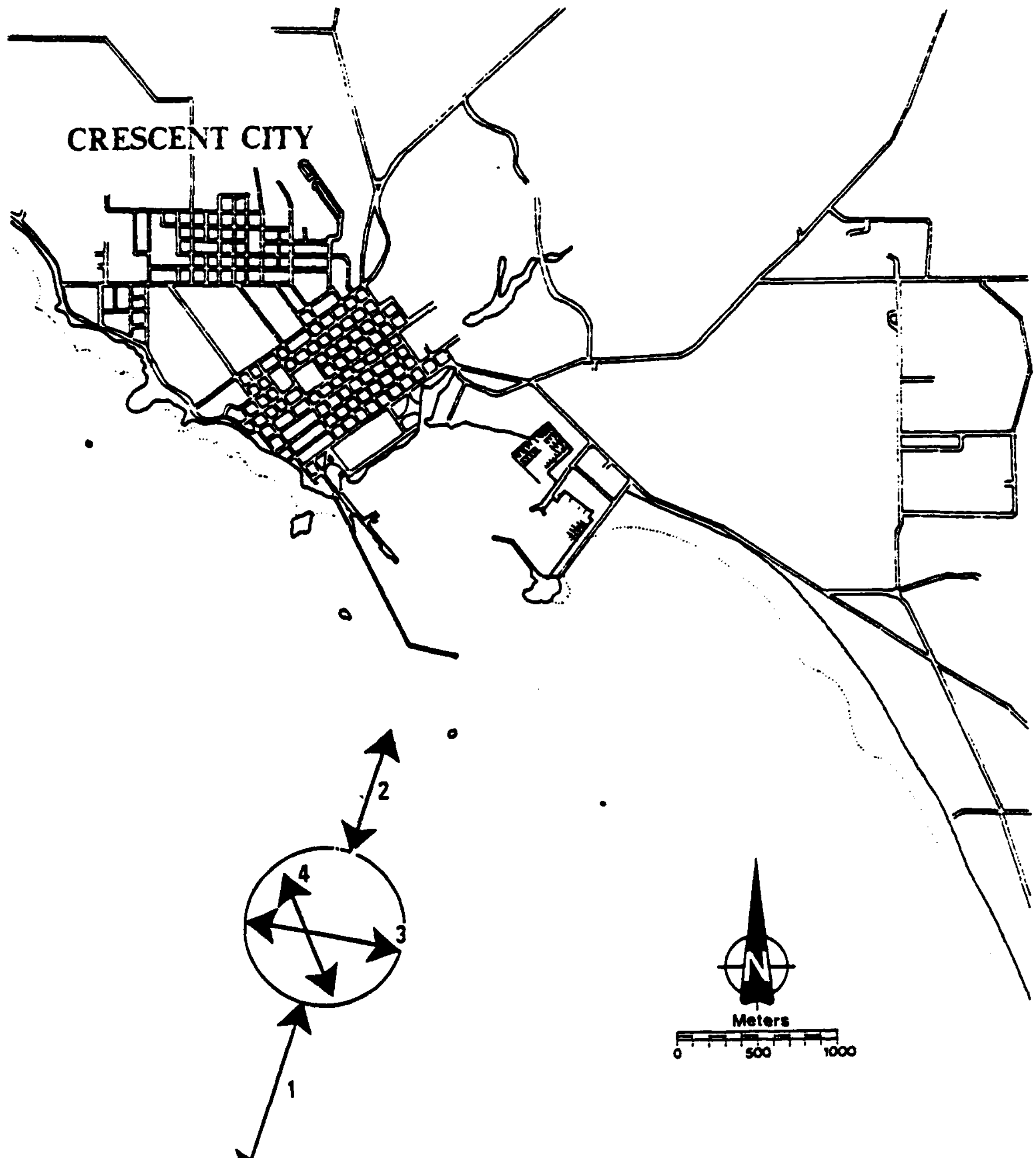

Figure 7. Transect locations for otter trawls near Crescent City Harbor, California, July 1979.

TABLE 1 TEMPERATURES AND CONDUCTIVITIES AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE CENTER, JUNE 1979

Depth (m)	Temperature (C)	Conductivity (µmho)
Surface	12.0	43,750
2	11.9	44,400
4	11.8	44,580
6	11.8	44,870
8	11.2	45,850
10	9.8	46,100
12	8.1	46,640
14	7.9	46,670
16	7.8	46,700
18	7.8	46,650
20	7.8	46,690
22	7.8	46,700
24	7.8	46,700
26	7.8	46,690

Current speeds ranged from 13.6 to 40.0 cm/sec, averaging 23.9 cm/sec one meter below the surface. Bottom current speeds ranged from 1.4 to 7.2 m/sec, averaging 3.7 cm/sec (Table 2). Current speeds measured at the thermocline (10 m) were less variable, ranging from 7.2 to 9.2 cm/sec with an average of 8.0 cm/sec during the study. Current direction was also variable from station to station and from surface to bottom (Table 2). Bottom current direction was northerly at all stations, ranging from readings of 271° N to 80° N. The variability in current speed and direction may be due to the heavy swells (2-3 m) at the time of measurement. The current direction at the disposal site center (355° N) was used to set the station locations for the subsequent chemical and biological studies.

Water quality profile results are presented in Table 3. Surface temperatures averaged 12.3 C and bottom temperatures averaged 7.8 C. Conductivity increased with increasing depth at all stations; however, there was little change in conductivity below the thermocline. Average dissolved oxygen levels were slightly depressed at the surface (10.0 ppm), increased to a maximum near the thermocline (10.4), and then dropped to low levels toward the bottom (2.6). pH levels ranged from 8.5 to 7.3 and decreased with depth, while turbidity values attained a minimum between 19 and 13 m.

All chemical contaminants analyzed in the seawater samples were below the detection levels of standard analytical techniques, except at the surface of stations 3 and 6 (Figure 4) where mercury levels were measured at 3 and 5 ppb, respectively (Table 4). The analysis of sediment samples at the disposal site and reference site stations revealed no detectable levels of chemical contaminants, except for phenol concentrations of 5 ppb at Stations 5 and 6 (Figure 4; Table 5).

The majority of sediment samples collected at the disposal and reference site stations were composed of medium- and fine-grained sands with particle sizes between 500 and 75 µm (Table 6). The sediment from Station 7, however, was primarily a mixture of shell fragments and silt with 56 percent of the sample having a particle size greater than 850 µm. Station R4 was selected as the reference site since the particle-size distribution was similar to that at the proposed disposal site.

Surface phytoplankton densities were measured by determining total chlorophyll per cubic meter of sea water. Densities ranged between 3.3 and 11.4 mg/m^3 overall, and averaged 5.06 during the day and 8.2 during the night (Table 7).

Over 5,300 organisms from 127 different taxa were collected in benthic grab samples at the proposed disposal site (Table 8). The most abundant organisms collected were the polychaete *Owenia collaris*, followed by the gastropod *Olivella pycna* and the bivalve *Epilucina californica*. Station 7 had a lower total organism density and fewer species present than the other stations. This difference may be attributable to the different substrate type (Table 6).

A total of 65 different taxa were collected in the 24 zooplankton tows at the proposed disposal site (Table 9). Nine taxa occurred at all stations; the copepods *Calanus pacificus* and *Pseudocalanus elongatus* and Cirripedia (barnacle) larvae were the most abundant organisms collected (Table 9).

TABLE 2 CURRENT SPEEDS AND DIRECTIONS AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Station	Depth (m)	Current Speed (cm/sec)	Current Direction (°N latitude)
A	1	13.6	346
	10	8.9	281
	13	6.4	261
	26	3.6	73
B	1	21.2	8
	10	7.8	329
	13	5.1	303
	26	4.4	67
C	1	40.0	333
	10	7.2	273
	17	5.1	311
	34	1.4	360
D	1	17.1	330
	10	7.3	299
	18	9.2	277
	36	3.6	271
E	1	28.4	325
	10	7.8	290
	16	9.8	266
	32	2.0	80
F	1	22.8	271
	10	9.2	4
	14	4.5	266
	28	7.2	355

TABLE 3 WATER QUALITY PARAMETERS AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Depth (m)	Station 1	2	3	4	5	6	7
				Temperature (C)			
1	12.2	12.5	12.2	12.2	12.5	11.8	12.5
4	11.6	11.8	12.1	11.9	11.9	11.4	11.9
7	10.9	11.0	10.9	11.6	11.5	10.9	11.5
10	10.5	10.9	8.6	10.7	9.9	9.7	11.3
13	8.4	8.8	8.0	9.3	9.2	8.3	10.7
16	8.0	8.3	8.0	8.7	8.4	7.9	9.6
19	7.8	7.9	8.0	8.5	8.3	7.9	8.7
22	7.7	7.9	8.0	8.3	8.1	7.8	8.4
25	7.6	7.7	7.7	8.1	7.9	7.7	
28	7.5	7.6	7.6	8.0	7.9	7.6	
31	7.5	7.5				7.5	
				Conductivity (μmho)			
1	44,580	43,400	44,820	45,500	43,700	44,600	45,500
4	46,070	45,920	45,380	45,950	45,510	45,000	46,460
7	45,950	45,950	45,940	46,390	45,910	45,500	46,850
10	45,940	46,150	46,540	46,450	46,010	46,300	46,910
13	46,300	46,440	46,600	46,480	46,100	46,500	46,850
16	46,410	46,570	46,600	46,670	46,270	46,750	46,810
19	46,370	46,540	46,720	46,780	46,350	46,740	46,950
22	46,410	46,580	46,870	46,850	46,350	46,710	46,950
25	46,440	46,630	46,910	46,890	46,460	46,730	
28	46,480	46,630	46,840	46,950	46,420	46,810	
31	46,530	46,600				46,820	
				Dissolved Oxygen (μg/l)			
1	10.1	9.9	9.6	10.4	9.8	10.1	10.4
4	10.5	10.3	10.0	10.6	10.6	10.2	10.5
7	10.8	10.2	10.1	10.6	10.5	10.1	10.5
10	11.2	10.9	8.0	10.0	9.6	9.9	10.1
13	8.3	8.8	4.5	8.4	9.1	8.7	9.4
16	6.1	8.8	3.9	7.3	6.8	2.7	9.0
19	2.6	3.0	3.2	6.7	6.6	2.4	6.8
22	2.5	2.4	3.0	5.6	5.5	2.3	5.5
25	2.1	2.2	0.9	4.6	3.4	1.2	
28	2.0	2.0	0.6	4.2	3.3	1.6	
31	1.6	1.9				1.3	

TABLE 3 (CONT.)

Depth (m)	Station 1	2	3	4	5	6	7
				pH			
1	8.2	8.3	8.3	8.3	8.5	8.3	8.3
4	8.2	8.2	8.3	8.3	8.4	8.2	8.3
7	8.2	8.2	8.2	8.3	8.3	8.2	8.2
10	8.2	8.2	7.9	8.2	8.1	8.1	8.2
13	7.9	7.9	7.6	7.9	8.0	7.9	8.1
16	7.2	7.9	7.5	7.8	7.8	7.5	8.0
19	7.4	7.4	7.4	7.7	7.7	7.4	7.8
22	7.4	7.4	7.4	7.6	7.6	7.4	7.7
25	7.4	7.4	7.3	7.6	7.4	7.3	
28	7.4	7.4	7.3	7.5	7.4	7.4	
31	7.4	7.4					
				Turbidity (NTU)			
1	1.2	1.0	0.5	1.1	0.7	2.0	0.9
4	0.7	0.9	0.6	0.7	0.3	0.5	0.7
7	0.7	1.0	0.6	0.6	0.4	0.5	1.0
10	0.5	0.7	0.9	0.4	0.3	0.5	0.8
13	0.6	0.9	0.5	0.8	0.5	0.5	0.9
16	0.6	0.7	1.0	0.9	0.6	0.7	0.8
19	0.6	0.8	1.0	1.3	0.6	0.7	0.8
22	0.8	1.1	1.1	1.6	1.7	2.4	0.9
25	1.1	1.5	1.6	4.6	1.2	1.8	
28	1.5	1.7	2.3	1.5	0.9	2.0	
31	1.1	--(a)				2.5	

(a) Voided sample.

TABLE 4 CONCENTRATIONS (ppm) OF CHEMICAL CONSTITUENTS IN WATER SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Chemical Constituent	Disposal Site Stations													
	1		2		3		4		5		6		7	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	<0.002	<0.002
Zinc	<0.1	<0.1	--	--	<0.1	<0.1	--	--	<0.1	≤0.1	--	--	--	--
Copper	<0.08	<0.08	--	--	<0.08	<0.08	--	--	<0.08	<0.08	--	--	--	--
Phenol	<0.004	<0.004	--	--	<0.004	<0.004	--	--	<0.004	<0.004	--	--	--	--
Oil & Grease (Freon extractable)	<1	<1	--	--	<1	<1	--	--	<1	<1	--	--	--	--
Chlorinated hydrocarbons	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

Note: -- means no chemical analysis was performed on that sample.

TABLE 5 CONCENTRATIONS (ppm) OF CHEMICAL CONSTITUENTS IN SEDIMENT SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Chemical Constituent	Field Blank	Station												
		Disposal Site							Reference Site					
		1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	≤0.002
Zinc	<0.1	<0.1	<0.1	<0.1	<0.1	≤0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Phenol	<0.004	<0.004	<0.004	<0.004	<0.004	0.005	0.005	<0.004	<0.004	≤0.004	≤0.004	0.004	<0.004	0.004
Oil & Grease (Freon extractable)	<1	≤1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorinated hydrocarbons	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls	<0.5	<0.5	<0.5	<0.5	<C.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

TABLE 6 PERCENTAGE (BY WEIGHT) RETAINED ON VARIOUS SIEVES OF SEDIMENTS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

		Station												
		Disposal Site							Reference Site					
Sediment Classification	Sieve Size[a]	1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Gravel	10 (2,000)	0.3	0.2	0.5	1.8	0.1	0.1	42.0	2.6	1.0	3.0	1.3	0.9	1.5
Coarse sand	20 (850)	1.0	0.6	1.4	0.6	0.7	0.7	13.9	2.2	1.3	1.3	1.2	1.9	2.3
Coarse sand	30 (500)	1.5	0.3	0.8	0.4	0.4	0.3	3.8	3.3	0.9	0.8	0.7	0.6	0.9
Medium sand	100 (150)	14.5	11.4	28.6	21.3	21.0	24.3	4.7	39.6	56.6	39	24.1	42.4	78.2
Fine sand	200 (75)	79.1	82.6	67.2	72.4	70.2	68.7	13.7	30.7	39.4	55.3	70.2	53.4	17.0
Silt	Pan (75)	3.6	4.9	1.5	3.5	7.3	5.9	21.9	21.6	0.9	0.6	2.5	0.9	0.1

(a) Opening size (m) is given in parentheses.

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TABLE 7 TOTAL CHLOROPHYLL CONCENTRATIONS (mg/m^3) AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Time	Station 1	3	5	6	7
Day	3.3	6.1	4.9	5.3	5.7
Night	9.9	5.4	11.4	5.9	8.4

TABLE 8 TAXONOMIC LIST AND NUMBERS OF BENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Taxon	Station 1	2	3	4	5	6	7
Cnidaria							
Anthozoa							
Actiniaria	1	2	1		1	8	
<u>Metridium</u> <u>senile</u>					1		
Scyphozoa							
Stauromedusae			1			1	
Annelida							
Polychaeta (unidentified)	16	21	11				
Ampharetidae	3	8	1	3		5	
<u>Aphrodita</u> <u>parva</u>	1						
Capitellidae					1	1	
<u>Mediomastus</u> <u>californiensis</u>	7	56	12	4	5	40	
Chaetopteridae	1	2			1		
Cirratulidae	1	1	1	1		1	
<u>Chaetozone</u> <u>setosa</u>	1	5	18	7	1	15	
<u>Cirratulus</u> <u>cirratus</u>	1						
<u>Tharyx</u> sp.	2						
<u>Tharyx</u> <u>multifilis</u>	26	30	8	12	3	12	
Glyceridae	1		1	2			
<u>Glycera</u> <u>convoluta</u>	1	2	1	8	2	10	
Goniadidae							
<u>Glycinde</u> <u>polygnatha</u>	17	79	40	21	15	54	
Lumbrineridae							
<u>Lumbrineris</u> <u>tetraura</u>	23	63	74	58	6	50	
Magelonidae							
<u>Magelona</u> <u>pitelkai</u>	9		16	14		5	

TABLE 8 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Nephtyidae							
<u>Nephtys</u> sp.	1	4					
<u>Nephtys</u> <u>caecoides</u>	53	27	42	19	3	42	
Nereidae			2			2	
Onuphidae							
<u>Nothria</u> <u>elegans</u>	39	39	9	15		36	
Orbiniidae		2	6	1		1	
<u>Haploscoloplos</u> <u>elongatus</u>	20	63	18	16	9	39	
<u>Naineris</u> <u>uncinata</u>	1		2	1		1	
<u>Phylo</u> <u>felix</u>	1	14	5	16		20	
Oweniidae		14	5				
<u>Myriochele</u> <u>pygidialis</u>	4	30		1		2	
<u>Owenia</u> <u>collaris</u>	92	701	1	16	3	2	
Phyllodocidae	2	2				2	2
<u>Eteone</u> sp.			1				
<u>Anaitides</u> <u>williamsi</u>	2	3	3	2		8	
Polynoidae	3			1		2	
<u>Lepidasthenia</u> <u>longicirrata</u>	1						
Sabellidae				5	1		2
<u>Sabella</u> <u>crassicornis</u>	2				1		1
Sigalionidae							
<u>Pholoe</u> <u>tuberculata</u>	4	21	1			11	
<u>Thalenessa</u> sp.	13	2	4	9		10	
Spionidae	2	15	12	3	1		
<u>Laonice</u> sp.	1						
<u>Polydora</u> sp.	1						
<u>Spiophanes</u> <u>berkeleyorum</u>			12	24	10	85	
<u>Spiophanes</u> <u>bombyx</u>	16		19	83	1	19	
Syllidae				2		1	1
Terebellidae	4				1		2

TABLE 8 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Arthropoda							
Cirripedia		4					
Malacostraca							
Cumacea	1				1	1	
Diastylis sp.	2	8	1	1	1	21	
Diastylopsis sp.					73	1	
Diastylopsis dawsoni	9	25	17	13	21	106	
Diastylopsis tenuis	4	3	7	47	1	11	1
Mesolamprops sp.				4			
Isopoda		1					
Synidotea biscuspida	3	3	1	1		21	
Munna sp.						5	
Amphipoda							
Gammaridea (unidentified)	3	23	4	8	2	15	
Ampelisca sp.	6	1				1	
Ampelisca agassizi	20	9					
Ampelisca macrocephala	41	2	30	17		30	
Cymadusa uncinata						1	2
Dulichia sp.			1				
Eohaustorius sp.				23			
Ischyrocerus sp.		7		1	3		2
Maera vigota				2			
Monoculodes spinipes				5	1		
Paraphoxus epistomus	38	11	13	48	1	3	
Parapleustes pugettensis					15		11
Photis bifurcata					1		
Photis brevipes		1				8	
Photis californica	2	4				2	
Photis conchicola	1	4		2			
Photis epistomus						13	
Photis sp.	5			8	2	21	2
Pleusymptes subglaber	1	2					
Caprella laeviuscula	1						

TABLE 8 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Decapoda							
Paguridae		1		1	1		
Pagurus beringanus				1	17		2
Callianassidae	2	1					
Brachyura							
Cancer magister	3		2	44	2		
Loxorhynchus crispatus					1		
Pinnotheridae		4		1		1	
Pinnixia sp.	1					3	
Caridea							
Heptacarpus sp.					1		
Heptacarpus brevirostris					1		1
Mollusca							
Polyplacophora							
Mopalia sp.					2		
Gastropoda		1					1
Prosobranchia							1
Calliostoma ligatum							1
Epitonium tinctum	2						
Mitrella sp.		1			1		
Mitrella gouldi	12	7	28			25	1
Nassarius fossatus				1			
Nassarius mendicus					2		1
Nassarius perpinguis	3		19	5			
Olivella pycna	14	5	73	524		4	
Amphissa sp.					1		1
Trichotropis cancellata					1		
Opisthobranchia	1					1	
Cyclichna sp.	14	4				1	
Diaphana californica		4		1		2	
Odostomia sp.	5	2				1	
Turbonilla sp.	4	1					

TABLE 8 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Gymnostomata		2	1			3	
Bivalvia (unidentified)		3				3	
Chlamys hastata							2
Epilucina californica	168	145	4	3		71	
Lyonsia californica	1						
Mytilidae	1						
Protothaca staminea				2	2		
Tellinidae	2		2	8		15	
Macoma sp.	1						
Macoma acolasta				1	1		
Tellina modesta	7	13	24	35	1	1	
Echinodermata							
Echinoidea	9	1			1	12	
Ophiuroidea	6		2	8		3	2
Amphipholis squamata					1		
Holothuroidea							
Cucumaria lubrica					1		
Eupentacta quinquesemita	27						
Ectoprocta					P[a]		P[a]
Phoronida	4			2	1	3	
Nematoda		1					

(a) P = present (usually a colonial form).

TABLE 8 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Nemertea	8	28	14	34	3	5	
Paleonemertea		7					
Heteronemertea		1					
Sipuncula	3	1	2	3			
Chordata							
Urochordata							
Ascidiacea					P[(a)]		P[(a)]

(a) P = present (usually a colonial form).

TABLE 9 TAXONOMIC LIST AND ABUNDANCES (no./1,000 m^3) OF ZOOPLANKTON COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night	Station 5 Day	Station 5 Night	Station 6 Day	Station 6 Night
Cnidaria												
Hydrozoa												
Hydroida (medusae)			10				150					
Scyphozoa						260						
Ctenophora												
Pleurobrachia bachei											5	
Annelida												
Oligochaeta			3									
Polychaeta (juveniles)	180			350	3	230				460		20
Magelona pitelkai		3										
Hirudinea												
Piscicolidae												37
Arthropoda												
Copepoda (unidentified)				500	80		210		2,840	40		300
Calanoida (nauplii)			10	500		450						
Calanoida (copepodite)					3					40		
Acartia clausi	930	520	100	660	200	690	1,250	240	140	270	90	960
Acartia longiremis		170	50		20			50	140	420	10	20
Acartia tonsa			20		20							
Epilabidocera longipedata					3					40	10	
Pseudocalanus elongatus	21,780	11,620	640	4,110	190	6,860	1,390	950	13,620	6,020	530	3,360
Tortanus discaudatus		180								40	2	
Centropages abdominalis			10		7						5	
Centropages tenuiremis											3	
Metridia pacifica			10			260		50		190	10	20
Calanus pacificus	37,040	24,130	3,270	7,390	1,540	10,080	16,420	7,640	33,620	2,800	1,240	4,540
Oithona plumifera					3							
Branchiopoda												
Cladocera												
Evadne nordmanni	620	180	860	1,200	530	1,820	1,550	980	570	840	420	210
Podon polyphemoides	4,320	11,280	3,420	12,180	2,790	13,970	5,710	3,420	7,660	7,150	2,220	4,010
Cirripedia (nauplii)	20,400	38,700	3,880	66,850	980	36,130	14,310	11,030	8,230	33,180	600	16,160
Cirripedia (cyprid)	1,230	5,800	160	3,780	800	17,880	830	330	1,130	19,690	40	2,080
Malacostraca												
Cumacea (unidentified)		180	10							40		90
Diastylopsis dawsoni					460					310		
Diastylopsis tenuis				500								210
Mesolampropos dillonensis				330								80
Mysidacea (juvenile)					3			50		80	5	2,540
Neomysis rayii	250			170							3	859
Acanthomysis columbiae											3	60
Acanthomysis macropsis											3	40
Acanthomysis sculpta												90

TABLE 9 (CONT.)

Taxon	Station 1 Day	1 Night	2 Day	2 Night	3 Day	3 Night	4 Day	4 Night	5 Day	5 Night	6 Day	6 Night
Amphipoda												
Monoculoides spinipes												370
Atylus tridens						230	140					
Hyperia medusarum			30									
Hyperoche sp.								30				
Eucarida												
Euphausiacea (calyptopis)	3,140	1,470	1,290	1,480	230	13,230	1,810	850	13,620	11,900	290	380
Euphausiacea (furcilia)	1,050	3,880	50	490	20	470	140	270	850	730	60	60
Decapoda												
Caridea				170	10							40
Hippolytidae Type 1	610	170	20	820		230	150			150	30	250
Hippolytidae Type 2	250				3					40		20
Crangonidae Type 1	180		3	330	10	230	140	70			10	40
Crangonidae Type 2					3			60			3	
Alpheidae (1)					3							20
Brachyura (zoea)					3							
Cancer productus (zoea)			3									40
Cancer magister (megalopa)			3									
Cancer oregonensis (zoea)												20
Xanthidae (zoea)			3			30				40	3	
Pinnotheridae (zoea)			6		3						5	
Majidae (zoea)	180		3									
Callianassidae												
Callianassa sp.			3	170				30				40
Paguridae												
Pagurus sp. 1	180	180		490	20	450				40	5	130
Pagurus sp. 2	180		3					50				40
Hippidae												
Emerita analoga											3	
Mollusca												
Gastropoda			3							120	5	
Phoronida					3					40		
Chaetognatha (unidentified)	250											
Sagitta sp.			3	170								
Sagitta euneritica		350	80	160	3		150	80		80	20	20
Chordata												
Urochordata												
Larvacea												
Oikopleura			50		3			20		150	10	
Osteichthyes (egg)	180		40		3					40	3	
Osteichthyes Type 53									140			
Osmeridae Type 1			3									19

Over 17,000 epibenthic organisms representing 38 taxa were collected in otter trawls (Table 10). The most abundant species collected were Dungeness crab (*Cancer magister*), Pacific tomcod (*Microgadus proximus*), and night smelt (*Spirinchus starksi*).

TABLE 10 TAXONOMIC LIST AND ABUNDANCES OF EPIBENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGE DISPOSAL SITE, JUNE 1979

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Chordata								
Pisces								
Agnatha								
Cyclostomata								
Eptatretus stoutii			1	1	--	--	--	--
Chondrichthyes								
Hydrolagus colliei		--	--	2	--	--	--	--
Squalus acanthias	--	--	--	--	1	--	--	--
Raja binoculata	2	--	--	2	--	3	4	5
Osteichthyes								
Teleostei								
Microgadus proximus	1,775	91	439	117	200	240	251	748
Spirinchus starksi	490	5	305	--	1,780	146	569	178
Sebastes flavidus	384	177	232	88	673	98	259	251
Citharichthys stigmaeus	20	151	91	91	41	254	59	187
Isopsetta isolepis	15	24	74	62	47	58	46	44
Parophrys vetulus	9	12	35	26	24	30	46	30
Stellerina xyosterna	3	3	--	2	13	29	--	43
Ophiodon elongatus	3	1	11	2	1	1	7	1
Liparis pulchellus	2	--	--	5	2	7	7	24
Pleuronichthys decurrens	2	--	1	--	4	--	1	1
Artedius sp.	3	--	--	1	2	--	--	2
Platichthys stellatus	--	--	1	2	1	--	1	--
Sebastes entomelas	--	1	1	--	2	--	1	--
Sebastes paucispinis	--	--	1	--	2	--	--	1
Leptocottus armatus	--	--	1	1	--	--	1.	--
Engraulis mordax	1	--	--	--	5	--	--	--

TABLE 10 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Clupea harengus pallasi	1	--	--	--	--	--	--	2
Psettichthys melanostictus	1	1	7	2	1	1	2	1
Sebastes sp.	--	--	--	1	--	1	--	--
Pholis ornata	--	--	1	--	--	--	--	--
Icichthys lockingtoni	1	--	--	--	--	--	--	--
Cottidae (unidentified)	--	--	--	1	--	--	--	--
Annelida								
Polychaeta (unidentified)	--	--	--	--	--	1	--	--
Arthropoda								
Crustacea								
Isopoda								
Lironeca vulgaris	1	--	--	--	--	--	--	--
Decapoda								
Caridea								
Pandalus danae	12	3	3	4	1	--	1	--
Crangon franciscorum	--	11	--	1	1	6	2	--
Crangon alaskensis elongata	--	--	--	8	1	2	1	--
Brachyura								
Cancer magister	188	5,800	3	16	342	50	12	331
Cancer gracilis	--	--	--	--	--	--	--	2
Anomura								
Pagurus beringanus	1	3	--	5	--	2	--	--
Mollusca								
Cephalopoda								
Loligo opalescens	8	1	11	--	7	--	19	--
Gastropoda								
Nassarius perpinguis	--	--	--	--	--	4	--	--

TABLE 10 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Echirodermata								
Asteroidea								
<u>Pisaster brevispinus</u>	1	--	--	--	6	--	1	5
<u>Pycnopodia helianthoides</u>	4	4	--	1	3	--	--	--
<u>Dermasterias imbricata</u>	--	1	--	--	2	--	--	--
<u>Luidia foliolata</u>	--	--	--	--	--	--	1	--

3. BIOASSAYS

3.1 INTRODUCTION

To assess the potential for impact of dredge disposal in ocean waters, the Register requires that liquid, suspended, and solid phase bioassay tests be performed on appropriate sensitive marine organisms. The tasks required for performing bioassay tests include (1) the establishment of a laboratory where the required testing environment can be maintained; (2) the collection of sediments from both the proposed dredge site and a suitable reference site; (3) the preparation of liquid, suspended, and solid phase test concentrations; (4) the selection, collection, and exposure of marine organisms to the bioassay treatments; and (5) analysis of data and presentation of results.

3.2 DESCRIPTION OF THE MOBILE BIOASSAY LABORATORY

All bioassay studies were conducted at Crescent City during the period 12 August - 15 September 1979 in EA's mobile laboratory. The mobile laboratory was equipped with 45 38-liter aquaria in a three tiered flow-through water bath. The use of an onsite facility offered the advantages of optimal coordination between species procurement and bioassay personnel; minimization of immediate and latent stress associated with translocation of organisms; unlimited use of reference site seawater for holding organisms and testing; and minimization of the potential for contamination and alteration of chemical characteristics of the seawater.

3.2.1 Seawater System

Reference site seawater was drawn from approximately 16 m offshore through two polyvinyl chloride (PVC) foot valves to a plastic impeller pump located adjacent to the mobile laboratory. The water was pumped into a 380-liter polyethylene header tank located on top of the mobile laboratory. A 102-μm mesh net positioned within the header tank was used for filtering the incoming seawater. Seawater flowing out of the header tank entered a manifold consisting of two PVC ball valves and three horizontal feeder lines. Seawater was then introduced into each aquarium through a 6.4-mm plastic fitting tapped into the feeder lines. Fine flow adjustments were made with a pinch clamp attached to a connecting vinyl tube. Seawater drained out of each aquarium into a trough through a 12-mm glass L-shaped standpipe. A drain in each trough carried the seawater back to the ocean. The seawater system was leached for 48 hours prior to testing.

3.2.2 Environmental Control System

All aquaria were held in a temperature bath consisting of six fiberglass troughs measuring 60 cm by 243 cm by 15 cm deep. Seawater flowed from the header tank through each trough at approximately 12 liter/min, maintaining a depth of 12 cm around each aquarium.

To provide adequate levels of oxygen in each aquarium, the mobile lab was equipped with a graphite-lubricated Conde air pump system. Brass valves and air stones were used to control and diffuse the air flow in each aquarium.

Lighting was provided by a bank of "cool white" fluorescent fixtures each measuring 121 cm long. The fixtures were hung 31 cm above the top of the aquaria, four fixtures per tier. The lights were timer controlled to provide a 14-hour light and 10-hour dark photoperiod.

3.3 SEDIMENT COLLECTION AND PHASE PREPARATION

Dredge site and reference site sediments were collected with a Smith-McIntyre grab sampler on three separate dates: 4, 8, and 16 August 1979. Five stations located in the dredge site (Figure 1) were randomly selected using a stratified sampling design. The sediment was transferred from the grab sampler to buckets rinsed with seawater which were immediately sealed and stored on ice. Onshore, the sediment-filled buckets were held at 4 C in a thermostatically controlled storage unit. A total of 323 liters of dredge material and 361 liters of reference material was collected for the study. Prior to testing, the reference and dredge materials were sieved through a 1-mm mesh screen to remove the larger organisms.

The suspended phase was prepared by first transferring dredge-filled buckets from cold storage to an onsite ice bath. Equal volumes of dredge material from the five dredge site stations were combined and added to acid-rinsed 113-liter aquaria each containing 15 liters of reference-site seawater. Dredge material was added until the water volume in each aquarium reached 30 liters. Reference-site seawater was then added until the water volume reached 75 liters, resulting in a sediment-to-water ratio of 1:4. Air lines passing through fitted aquarium lids were used to vigorously mix the sediment-water mixture for 30 minutes. During this period the slurry was further mixed by manually stirring at 10-minute intervals. After settling for one hour, the supernatant was decanted into acid-cleaned 75.7-liter aquaria for dispersal into appropriate test containers.

The liquid phase elutriate was initially prepared in the same manner as the suspended phase. The supernatant was filtered, however, through a series of five filters before being transferred to test aquaria. The filter system consisted of four 50-cm Filtrite depth filters and a sterilized 0.45-µm dynaflow filter.

The solid phase was prepared by filtering the collected dredge material through a 1-mm mesh screen to remove organisms. A 15-mm layer of the filtered dredge material was then added to test aquaria containing a 30-mm layer of filtered reference material.

3.4 SPECIES SELECTION AND PROCUREMENT

Appropriate marine organisms are those that are indigenous to, or closely related to organisms that are indigenous to, the geographic region of the disposal site. Although the test species should be sensitive to potential chemical contaminants in the dredge material, they should not be overly susceptible to collection and handling stress. At least one species each representative of a phytoplankton or a zooplankter, a fish, crustacean or gastropod, and fish species is required by 40 CFR 227.27 for the suspended and liquid phase testing. For the solid phase testing, 40 CFR 227.27 states that one species must be chosen to represent each of the following classifications: a filter-feeder, a deposit-feeder, and a burrower. In addition,

one of the test species in the solid phase should be of a large enough size for chemical analysis of its tissues to determine bioaccumulation potential.

Representatives of the Army Corps of Engineers (San Francisco District), and the Environmental Protection Agency (Region IX), after consultation with the California Department of Fish & Game, and the U.S. Fish and Wildlife Service, jointly selected the following species as being appropriate sensitive marine organisms for bioassay testing: the zooplankter Calanus pacificus, the speckled sanddab (Citharichthys stigmaeus) and the Dungeness crab (Cancer magister) for the liquid and suspended phase tests; the polychaete Nephtys caecoides as the burrower, the sea cucumber Eupentacta quinquesemita as the filter-feeder, and the gastropod Olivella biplicata as the deposit-feeder, for the solid phase test.

A brief discussion of the life history, criteria for selection, and method of collection for each species follows.

3.4.1 Calanus pacificus

Calanus pacificus is a marine calanoid copepod found in surface waters of the northern Pacific Ocean (Esterly 1924; Brodskii 1967). Individual life expectancy for a related species, C. finmarchicus, varies with the climate; among arctic populations, an overwintering individual may live up to seven months, whereas in the temperate zones the average life span is closer to two months (Brodskii 1967). The latter case may be expected for C. pacificus, with one month required to mature from egg to adult and one month to ripen the eggs in preparation for spawning. Calanus species exhibit both seasonal and diurnal migration, which may be related to temperature, light intensity, availability of food, or a combination of these factors. In general Calanus feed on diatoms and other microplankton (Marshall and Orr 1972) and is itself a major dietary component of the sardine (Brodskii 1967).

Calanus pacificus was the most abundant species of copepod found during the field survey with densities averaging $149/m^3$, outnumbering other species in both day and night oblique tows.

Calanus pacificus is considered an appropriate sensitive bioassay species because of its abundance at the disposal site, filter feeding habit, and ease of collection.

Calanus pacificus were collected for the liquid and suspended phase bioassays in two-minute surface tows in ocean waters off Crescent City Harbor with either a 100-μm or 333-μm mesh net. After each tow, the codend of the net was immediately emptied into an aerated plastic bucket of filtered seawater. The identification of Calanus pacificus was confirmed under a dissecting microscope in the mobile laboratory. Individuals were captured with a pipette and transferred to holding dishes, taking care not to expose them to air. Glass plates partially covered each dish, leaving enough space for adequate air exchange. The dishes were held in the water bath for 24 hours before testing to allow time for handling mortality to become evident.

3.4.2 Citharichthys stigmaeus

Speckled sanddab (Citharichthys stigmaeus) is a small bothid flatfish occurring from Baja California to southeastern Alaska (Hart 1973). A dominant species inhabiting soft bottom sediments, the sanddab is generally found at depths shallower than 50 m. The life span is approximately 40 months with adults growing to a maximum size of 170 mm (Ford 1965; Miller and Lea 1972). Recruitment occurs in late spring, summer, and early fall. The population size varies seasonally with a late fall and early winter decline attributed to predation by halibut and other large demersal species (Ford 1965).

Speckled sanddab was the fourth most abundant fish species collected in the otter trawl during the field survey. More abundant species collected (Microgadus proximus, Spirinchus starksi, Sebastes flavidus) were considered either too large or overly susceptible to handling stress. Speckled sanddab has survived well under laboratory holding conditions (Ford 1976; Ehrlich et al. 1979) and has been used successfully in other west coast bioassay studies (Lockheed 1979). It is also easily identified in collections, thus minimizing the degree of handling stress associated with species sorting.

Juvenile sanddabs were collected by otter trawl in shallow water (7-10 m) near Crescent City. All specimens from each tow were initially transferred to aerated 70-liter holding trays for sorting. The sanddabs were then placed in plastic lined oxygen-aerated trays. Ice was placed on the outside of the plastic lining to keep the temperature within 4 C of ambient. Approximately 50 sanddabs ranging in size from 30 to 130 mm with an average size of 90 mm were collected in each tow. Following collection and transfer to the mobile lab, the sanddabs were held at least 72 hours prior to testing in 38-liter flow-through aquaria containing 10 mm of sand.

3.4.3 Cancer magister

The Dungeness crab (Cancer magister) is found from Baja California to Unalaska, Alaska. The preferred depth range of the crab is 10 to 85 m, although they can be found from the shoreline out to 250 m. Bays, such as Humboldt and Crescent City, serve as nurseries for juvenile Dungeness crabs, but very few legal size adults are caught in these areas. Common foods of the adult crab include fish, shrimp, gastropods, worms, and other crabs. Cannibalism of young or injured individuals is not uncommon (Weymouth 1916).

Dungeness crabs pass through several larval stages (Brown and Caldwell 1971) within approximately five months, before metamorphosing into juveniles (Dahlstrom 1973). Juveniles and adults grow by molting of the exoskeleton; juveniles molt 8 to 11 times in the first year after metamorphosis (Brown and Caldwell 1971). It takes Dungeness crabs four or five years to attain the legal capture size of 15.8 cm.

During the initial field survey, juvenile Dungeness crab was one of the most abundant invertebrates collected near the proposed disposal site. They occurred in both benthic grab samples and otter trawls with the majority of crabs being of a size convenient for bioassay (about 30-mm carapace width). The waters off Crescent City are known to support major nurseries for juvenile Dungeness crab (Dahlstrom 1973). Studies by Mayer (1973) and Ebert et al. (1975) have shown that adult and juvenile Dungeness crabs are tolerant

of holding stresses. Orcutt et al. (1976) were successful in culturing Dungeness crabs in the laboratory.

Juvenile Dungeness crabs were collected by otter trawl in 20 to 30 m of water in an area adjacent to and just north of the proposed disposal site. The distribution of juvenile crabs was patchy with tow numbers varying considerably. Transport and handling procedures were similar to those used for speckled sanddabs.

3.4.4 Nephtys caecoides

Nephtys caecoides is a common polychaete that ranges from British Columbia to Mexico (Hartman 1968). Its distribution is determined by the availability of suitable substrate such as fine sand and sandy mud. According to Clark and Haderlie (1962), substrate type may be the ecological factor that separates Nephtys caecoides from Nephtys californiensis.

Nephtys caecoides was selected to fulfill the requirement for testing of an infaunal burrowing organism. It was one of the most abundant polychaetes collected during the field survey and has been successfully maintained under laboratory conditions. Lockheed (1979) used Nephtys caecoides as a test species in a similar solid phase bioassay study.

Nephtys caecoides used in this study were collected in Tomales Bay by Brezina and Campbell, Inc., Dillon Beach, California. They were delivered in aerated coolers to Trinidad Marine Lab, Trinidad, California, where they were held in flow-through seawater trays, and fed finely ground TetraMin prior to transport to the onsite mobile laboratory for testing.

3.4.5 Eupentacta quinquesemita

The sea cucumber Eupentacta quinquesemita occurs on intertidal rocks from Pacific Grove, California to Sitka, Alaska (Ricketts and Calvin 1968). During the initial field survey, sea cucumbers were collected at the proposed disposal site and were found clinging to the uppersides of docks and boat berths in Crescent City Harbor. The sea cucumbers, ranging in length from 1 to 10 mm, occur in large aggregates, often several hundred in number. The organisms can be found in tidal channels on the blades of the algae Laminaria spp. (Boyd and DeMartini 1977). Sea cucumbers feed by trapping detritus and plankton on highly branched oral tentacles (Boolootian 1966).

The filter feeding habit and abundance of sea cucumbers in the Crescent City area made it an ideal organism for the solid phase bioassay. In addition, the organism's large size and relative immobility are two characteristics desirable for bioaccumulation studies.

All sea cucumbers were collected by hand during low tide from offshore rocks near Luffenholz Beach, Trinidad, California. They were picked off the rocky substrate and placed in partially filled seawater buckets. The sea cucumbers were then taken to Trinidad Marine Lab where they were held in a 680-liter flow-through seawater tank until needed for testing. Collecting and holding survival was excellent.

3.4.6 Olivella biplicata

Olivella biplicata is a medium-sized gastropod that ranges from Vancouver Island to Baja California (Morris 1966). It inhabits clean sand near harbor mouths, lagoon entrances and protected sandy areas of the open coast. It is also abundant in shallow water offshore of exposed sandy beaches (McLean 1978). Olivella biplicata is a deposit-feeding burrower than can grow to a size of 25 mm.

Although Olivella biplicata was not collected during the field survey, it was found at the reference site during organism collection for the bioassay study. Olivella pycna was collected during the field survey but was not selected because of its small size. Boyd and DeMartini (1977) also found Olivella biplicata in their survey of the Crescent City beach intertidal and subtidal area.

Olivella biplicata were collected by hand at low tide near Moss Landing, California. The collected gastropods were placed in plastic buckets containing seawater and sediment. The buckets were then sealed and air shipped to Arcata, California, where they were transported to Trinidad Marine Lab and held in a flow-through seawater system until needed. The gastropods were fed finely-ground TetraMin during the holding period.

3.5 LIQUID AND SUSPENDED PHASE TESTS

3.5.1 Methods

A completely randomized design of five treatments with five replicates per treatment, ten organisms per replicate, was used for both suspended and liquid phase bioassay tests. The five treatments were concentrations of 100, 50, 10, and 0 percent of prepared liquid phase or suspended phase material (Section 3.3), plus an artificial seawater (Instant Ocean) control. The treatments were randomly assigned to 25 aquaria and 25 zooplankton dishes.

Standard 37.8-liter all glass aquaria were used as test containers for the speckled sanddabs and Dungeness crabs. The aquaria were equipped with acrylic partitions to separate the crabs from each other and from the fish. Thin sheets of cellophane were placed over the top of each aquarium to keep the sanddabs from jumping out. Crystallizing dishes (100 mm x 50 mm) fitted with glass covers were used as test containers for the zooplankton Calanus pacificus. Prior to testing, the aquaria, partitions, and dishes were washed with a detergent, rinsed with tap water, soaked in a 10 percent HCl bath for at least four hours, rerinsed thoroughly with tap water and finally rinsed with deionized water.

Each bioassay test was initiated as soon as the first organism was placed in a test container. The fish and crabs were netted from the holding aquaria and randomly distributed among test tanks. The zooplankton were transferred by eyedropper from their holding dishes to the test dishes which were in turn placed on top of the aquarium partitions.

The number of live organisms in each test container was recorded initially and at 4, 8, 12, 24, 48, 72, and 96 hours. In addition, temperature, conductivity, dissolved oxygen, and pH were measured in each aquarium during the

survival monitoring checks. Chemical parameters were not measured in the zooplankton dishes due to the potential for physical change.

Aeration was supplied to all test aquaria. Following the 48-hour check, the sanddabs were fed TetraMin and the crabs were fed small pieces of anchovy. Zooplankton were fed cultured phytoplankton at 24-hour intervals.

3.5.2 Results and Discussion

The survivals of speckled sanddab and Dungeness crab were high (>80%) in all treatments for both suspended and liquid phase bioassays (Tables 11 and 12). Survival of Calanus pacificus was somewhat lower (Table 13) but was unrelated to dredge material concentration. Since the three species exhibited greater than 50 percent survival for all treatments in both phases, a calculation of the LC50 value and thus a limiting permissible concentration (LPC) could not be made. No significant difference in survival between the 100 percent concentration and control was detected in either the suspended or liquid phase bioassay for any of the three species tested.

Speckled sanddab survival was 100 percent for all treatments in the suspended phase. The fish were active, displayed no signs of stress, and fed readily at the 48-hour checkpoint. Sanddab survival was also 100 percent in the liquid phase with the exception of two replicates. One of the replicates in the 10 percent concentration treatment had an aeration line failure, resulting in the loss of all fish in the tank. In addition, one fish jumped out of a test tank in the 50 percent treatment. These two occurrences were the only fish mortalities in the liquid phase bioassay.

The only mortalities of Dungeness crab in the suspended phase bioassay were attributed to cannibalism among newly molted crabs. The acrylic partitions originally designed to separate the crabs from one another proved ineffective because of the crabs' ability to swim up and over the partitions into adjoining sections. This problem was solved during the liquid phase by placing an acrylic lid over the partitions in each tank. This eliminated the possibility of cannibalism by restricting the crabs to individual sections. There was only one crab mortality in the entire liquid phase test and this occurred in the artificial seawater control.

Cochran's test for homogeneity of variances revealed no significant differences in the variance for zooplankton survival among the three treatments in either the suspended or liquid phase tests (Tables 14 and 15).

Survival of Calanus pacificus in the suspended phase was lower in the 100 percent concentration (80 percent) than in either control (96 and 88 percent). The results of an analysis of variance (ANOVA) showed no significant difference in survival among the two controls (artificial sea water and 0 percent test concentration) and the 100 percent suspended phase test concentration (Table 14).

Survival of Calanus pacificus in the liquid phase was lower in the 100 percent concentration (76 percent) than in either control (80 and 84 percent). An ANOVA detected no significant difference in survival among the two controls and the 100 percent liquid phase test concentration (Table 15).

TABLE 11 PERCENT SURVIVAL OF CITHARICHTHYS STIGMAEUS EXPOSED TO FIVE TREATMENTS IN SUSPENDED AND LIQUID PHASE BIOASSAY TESTS, AUGUST 1979

Treatment[a]	Suspended Phase	Liquid Phase
Artificial seawater	100	100
0 percent test concentration	100	100
10 percent test concentration	100	80[b]
50 percent test concentration	100	98[c]
100 percent test concentration	100	100

(a) Five replicates (50 organisms total) were used in each treatment.
(b) One entire replicate lost due to aeration line failure.
(c) One fish jumped out of a test aquarium.

TABLE 12 PERCENT SURVIVAL OF CANCER MAGISTER EXPOSED TO FIVE TREATMENTS IN SUSPENDED AND LIQUID PHASE BIOASSAY TESTS, AUGUST 1979

Treatment[a]	Suspended Phase	Liquid Phase
Artificial seawater	98	98
0 percent test concentration	96	100
10 percent test concentration	96	100
50 percent test concentration	96	100
100 percent test concentration	98	100

(a) Five replicates (50 organisms total) were used in each treatment.

TABLE 13 PERCENT SURVIVAL OF *CALANUS PACIFICUS* EXPOSED TO FIVE TREATMENTS IN SUSPENDED AND LIQUID PHASE BIOASSAY TESTS, AUGUST 1979

Treatment[a]	Suspended Phase	Liquid Phase
Artificial seawater	96	80
0 percent test concentration	88	84
10 percent test concentration	92	86
50 percent test concentration	92[b]	82
100 percent test concentration	80	76

(a) Five replicates (50 organisms total) were used in each treatment.
(b) One replicate lost during the 48-hour check.

TABLE 14 ANALYSIS OF VARIANCE TEST (ANOVA) AND COCHRAN'S TEST FOR HOMOGENEITY OF VARIANCES APPLIED TO *CALANUS PACIFICUS* IN THE SUSPENDED PHASE BIOASSAY

ANOVA

Source	DF	SS	MS	F
Total	14	20.4		
Treatment	2	6.4	3.2	2.7 N.S.
Error	12	14	1.16	

COCHRAN'S TEST

Critical value for Cochran's test with 4 degrees of freedom and 3 variances = 0.74.

Cochran's calculated test statistic = 0.57 N.S.

Note: N.S. = Nonsignificant

TABLE 15 ANALYSIS OF VARIANCE TEST (ANOVA) AND COCHRAN'S TEST FOR HOMOGENEITY OF VARIANCES APPLIED TO *CALANUS PACIFICUS* IN THE LIQUID PHASE BIOASSAY

ANOVA

Source	DF	SS	MS	F
Total	14	42		
Treatment	2	1.6	0.8	0.23 N.S.
Error	12	40.4	3.4	

COCHRAN'S TEST

Critical value for Cochran's test with 4 degrees of freedom and 3 variances = 0.74.

Cochran's calculated test statistic = 0.42 N.S.

Note: N.S. = Nonsignificant

3.6 SOLID PHASE TESTS

The greatest potential for environmental impact in the ocean dumping of dredge material lies in the solid phase. Bottom-dwelling animals live and may feed in and on the deposited solid phase for extended periods.

The solid phase bioassay, as described in the Manual, attempts to determine the potential for impact of the dredge material on organisms living outside the disposal site boundaries after initial mixing. It does not attempt to separate the effect due to the physical presence of the sediment from the effect due to some chemical constituent associated with it. The CE expressed concern over the possibility of physical impacts on test organisms due to the presence of small wood chips and broken gastropod shells in the dredge material. In an attempt to identify and separate physical impacts from the test, a study using the sea cucumber Eupentacta quinquesemita was designed, implemented, and the results analyzed prior to initiation of the solid phase bioassay.

3.6.1 Bioassay Pilot Study

3.6.1.1 Methods

The main objectives of the pilot study were to: (1) determine if the presence of wood chips and shells in the dredge material had an effect on survival, and (2) determine if the introduction of dredge material on top of the sea cucumbers had an effect on survival. To meet these objectives the following six treatments were established: (1) filtered dredge material (wood chips and shells removed) was added on top of established organisms, (2) unfiltered dredge material was added on top of established organisms, (3) organisms were introduced on top of filtered dredge material, (4) organisms were introduced on top of unfiltered dredge material, (5) organisms were introduced on top of a mixture of unfiltered dredge and reference material, and (6) organisms were introduced on top of a reference material control. A randomized block design of six treatments was applied over two test periods (blocks) each five days long, three treatments per period, five replicates per treatment, 20 sea cucumbers per replicate.

All test aquaria were initially prepared by placing an even 30-mm layer of reference sediment over the bottom. The test dredge material was mixed with a small amount of reference site seawater to produce a slurry prior to addition to the aquaria. Enough dredge material to produce a 15-mm layer was then evenly distributed over the water surface. Both the reference and dredge sediments were allowed to settle for one hour before the flow-through reference site seawater system was turned on. The removal of wood chips and gastropod shells from the filtered dredge material was accomplished by sieving the original dredge sediment through a 1-mm mesh screen.

Temperature, conductivity, dissolved oxygen, and pH were monitored daily in all tanks. The water level in each tank was maintained between 7 and 12 mm above the water sediment interface.

3.6.1.2 Results and Discussion

There was 100 percent survival of sea cucumbers in all six treatments in the pilot test. The sea cucumbers displayed no signs of stress or latent effects at the end of each five day test period. In treatments 1 and 2, the only discernable effects due to the addition of the dredge material was the rapid withdrawal of the sea cucumbers' feeding apparatus. After 24 hours, however, normal feeding activity had resumed. In treatments 3-6, the introduced sea cucumbers moved to the sides of the aquaria and assumed a typical distribution.

In all treatments, the majority of the sea cucumbers (95 percent) attached themselves to the aquarium sides, sometimes in groups of 3 to 5. Approximately half of the organsms positioned themselves at the air-water interface, the other half at the water-sediment interface. At any one time, approximately 20 percent of the organisms were observed to be actively feeding. Evisceration was observed among the test organisms but was infrequent, was not treatment-related, and did not result in any deaths. Sea cucumber evisceration has been observed in laboratory specimens and in natural habitats (Barnes 1974; Swan 1961).

The results of the pilot test demonstrated that sea cucumbers withstood direct physical effects of dredge material addition. The presence of wood chips and shells in the dredge material did not appear to have an adverse effect. Consequently, subsequent bioassays were conducted by introducing unfiltered dredge material on top of established organisms as recommended in the Manual and which represents disposal conditions.

3.6.2 Solid Phase Tests

3.6.2.1 Methods

The solid phase test consisted of two treatments with 10 replicates per treatment, three species per replicate, 20 organisms per species in a completely randomized design. The two treatments were: (1) unfiltered dredge material added on top of established organisms, and (2) reference material added on top of established organisms. In both treatments a 30-mm layer of reference sediment was initially placed in each test aquarium.

The first organisms added to the aquaria were the polychaetes, Nephtys caecoides (averaging 30 mm in length). They were seived from holding tank sediments and transferred to the test aquaria where they immediately burrowed into the bottom sediment. After 12 hours, two out of 400 of the Nephtys caecoides had died and were replaced. At the same time, twenty Olivella biplicata were added to each aquarium. Eighteen hours later, the gastropods were well established in the sediment with no apparent mortalities at which time the sea cucumbers were added. After 48 hours the dredge material and reference sediment was added using the procedures outlined in the pilot study. Each day during the ten day test period, temperature, conductivity, dissolved oxygen, and pH were measured, and checks were made for obvious mortalities (Appendix B).

At the end of the test period all live organisms were retrieved and enumerated. The sea cucumbers were transferred to clean, sediment free, flow-

through aquaria for purging for bioaccumulation evaluation. The sediment from all tanks was passed through a 0.5-mm mesh screen for retrieval of the polychaetes and gastropods.

3.6.2.2 Results and Discussion

There was 100 percent survival among the *Eupentacta quinquesemita* and the *Olivella biplicata* in both treatments (Table 16). There was no significant difference in survival of *Nephtys caecoides* between the dredge material treatment (98.5 percent) and the reference sediment treatment (99 percent).

3.7 BIOACCUMULATION TEST

The bioaccumulation test is intended to assess the potential for the long-term accumulation of toxins in the food web. A field assessment of bioaccumulation potential was not possible at the proposed disposal site since there have been no dredge material disposals at that site. Instead, an assessment of bioaccumulation was performed in EA's onsite mobile laboratory.

3.7.1 Methods

Twenty sea cucumbers were added to each of 20 aquaria which had been previously prepared in a manner identical to that described for the solid phase bioassay tests. After a 30-hour acclimation period, dredge material was added to 10 randomly selected aquaria and reference sediment was added to the remaining 10 aquaria. At the end of the 10-day test period, the sea cucumbers were placed in clean 37.8-liter flow-through aquaria for 48 hours to allow for purging. Sixty-six organisms from each treatment were randomly combined into three samples to obtain sufficient tissue for analysis. The samples were individually homogenized and analyzed for tissue levels of chlorinated hydrocarbons, polychlorinated biphenyls, cadmium, mercury, oil and grease, petroleum hydrocarbons, and phenol by Brown and Caldwell, Emeryville, California.

3.7.2 Results and Discussion

There were no detectable levels of chlorinated hydrocarbons or polychlorinated biphenyls in any of the tested samples (Table 17). Levels of cadmium, mercury, and petroleum hydrocarbons in tissues from aquaria containing dredge material were either equal to or less than the levels in tissues from aquaria containing reference material. Average phenol concentrations were higher in tissue samples from organisms exposed to dredge material (66 ppb) than in tissue samples from organisms exposed to reference material (30 ppb) but an ANOVA and Cochran's test showed that these differences were not significant (Table 18). The average levels of phenol (48 ppb) detected in these tests are lower than the average levels (246 ppb) detected in the littleneck clam (*Protothaca staminea*) by Lockheed (1979) in a similar bioaccumulation study of dredge materials from Humboldt Bay, California.

TABLE 16 PERCENT SURVIVAL OF *NEPHTYS CAECOIDES*, *OLIVELLA BIPLICATA*, AND *EUPENTACTA QUINQUESEMITA* EXPOSED TO TWO TREATMENTS IN THE SOLID PHASE BIOASSAY TEST, SEPTEMBER 1979

Species[a]	Treatment	
	Dredge Material	Reference Material
Nephtys caecoides	98.5	99
Olivella biplicata	100	100
Eupentacta quinquesemita	100	100

(a) Ten replicates (200 organisms total) were used in each treatment.

TABLE 17 CHEMICAL ANALYSIS RESULTS (IN PPM) OF TISSUES FROM *EUPENTACTA QUINQUESEMITA* EXPOSED TO TWO TREATMENTS IN THE LABORATORY BIOACCUMULATION STUDY, SEPTEMBER 1979

	Treatment					
	Dredge Material			Reference Material		
Chemical Constituent	Rep 1	Rep 2	Rep 3	Rep 1	Rep 2	Rep 3
Chlorinated Hydrocarbons	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Polychlorinated Biphenyls	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	<0.03	<0.03	<0.02	0.03	<0.03	<0.02
Mercury	0.011	0.009	0.012	0.016	0.015	0.022
Oil and Grease (Freon extractable)	34,580	36,515	38,180	40,965	41,860	42,590
Petroleum Hydrocarbons as Percent of Oil & Grease	1.6	<1.0	<1.0	4.8	1.5	<1.0
Phenol	0.08	0.08	0.04	0.04	0.04	0.01

TABLE 18 ANALYSIS OF VARIANCE TEST (ANOVA) AND COCHRAN'S TEST FOR HOMOGENEITY OF VARIANCES APPLIED TO PHENOL CONCENTRATIONS IN THE BIOACCUMULATION STUDY

ANOVA

Source	DF	SS	MS	F
Total	5	0.0037		
Treatment	1	0.0020	0.002	4.7 N.S.
Error	4	0.0017	0.00043	

COCHRAN'S TEST

Critical value for Cochran's test with 4 degrees of freedom and 3 variances = 0.975.

Cochran's calculated test statistic = 0.81 N.S.

Note: N.S. = Nonsignificant

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APPENDIX C

NATURAL RESOURCES APPENDIX

APPENDIX C

NATURAL RESOURCES APPENDIX

I. INTRODUCTION

This appendix contains a discussion of the coordination and input of data of the various resources agencies, especially the U.S. Fish and Wildlife Service in accordance with the requirements of the Fish and Wildlife Coordination Act, as amended. All correspondence referenced in this appendix has been attached.

II. SCOPING MEETING

On 28 November 1979 a scoping meeting to determine the concerns to be addressed in the EIS and to identify the significant areas related to the proposed action was held. Only four agencies other than the Corps attended. They included the U.S. Fish and Wildlife Service (FWS), the State Department of Fish and Game (DFG), the National Marine Fisheries Service (NMF) and the U.S. Environmental Protection Agency (EPA).

The area of greatest concern to the agencies was the method of construction, blasting, to complete the deepening. Alternative methods of construction were suggested. The duration of construction was also of concern.

Comments on the results of the field surveys at the proposed ocean disposal site were also solicited. DFG raised concern of the presence of crab fishermen at the site. FWS indicated that commercial fishermen should not be a problem since commercial fishing is not allowed inside a 3 mile limit.

FWS indicated that the bioassays would not be representative of bottom conditions at the disposal site due to the oxygenation during the bioassays.

The Corps responded that the bioassays are designed with the simulation of bottom conditions and with regard to measuring chemical pollutant impacts rather than physical impacts. If dissolved oxygen had not been maintained during the tests, the cause of deaths would not be certain since both chemical constituents and low dissolved oxygen would be at play.

III. COORDINATION WITH THE U.S. FISH AND WILDLIFE SERVICE

Coordination with the U.S. Fish and Wildlife Service concerning this authorized project has been on-going since February 1979. Coordination with the Endangered Species Office and its program was initiated by letter dated 20 June 1979 to the Regional Director. On 28 May 1981 a final report was provided by the Division of Ecological Services in Sacramento, California. The following recommendations were provided:

1. The authorized plan, as modified, be selected.
2. Construction be accomplished between 1 August and late November.
3. Dredging in the harbor entrance be coordinated with the harbormaster to minimize fishing boat access problems for fishermen.

In response to these recommendations, the construction of the selected plan, as modified, shall be accomplished between 1 August and late November. In addition, dredging in the harbor entrance shall be coordinated with the harbormaster to minimize fishing boat access problems.

IV. LIST OF ATTACHMENTS

1. Scoping Meeting Agenda, 28 November 1979
2. FWS final report, 28 May 1981
3. DFG letter of concurrence, 27 January 1981
4. FWS Endangered Species updated listing, 4 May 1981
5. FWS Assessment on Endangered Species, 7 May 1981
6. NMFS letter discussing blasting 28 March 1980
7. FWS letter reply for endangered species listing, 18 September 1979
8. FWS letter discussing blasting, 21 February 1979

AGENDA - SCOPING MEETING

CRESCENT CITY HARBOR NAVIGATION PROJECT

28 NOVEMBER 1979

Purpose:	Determine the scope of issues to be addressed and identify the significant issues related to the proposed action.
Proposed Action:	Deepen the Crescent City Inner Harbor Basin to -20 and widen the basin adjacent to the Petroleum Dock and a 400-foot breakwater extension. Project would require the removal of about 43,200 cy rock and about 55,000 cy of sediment.
Authority:	Congressional Authorization in 1965 for construction under River and Harbor Act of 1965.
Previous Studies:	A GDM was prepared in 1971. An EIS was prepared in December 1971 and was filed with CEQ in March 1972.
Completed Work:	Breakwater was completed in 1973, and the dredging was deferred.
Alternatives:	Dredging and disposal. Discuss: Methods to minimize impact.

Coordination

Need for Action

Schedule

ALTERNATIVES

1. Ripping the rock.

Corps proposed ripping the rock w/the Oski, a vessel used in Coos Bay to remove relatively soft rock. We wanted to perform a test rip to determine the feasibility of such an operation. The vessel operator travelled to Crescent City for a site inspection. It was his opinion, based on the surrounding rock, that the material could not be ripped out. He requested core samples before he would put his rig on site. A contract was awarded on 24 September to provide the Corps with borings over the dredge site. As of 25 October the Contractor had not started. He has since left the job and there is a 10 day period in which he has to return.

Still do not know hardness of rock.

After a determination is made on the velocity of the rock, there is a high probability that this velocity will be in the marginal zone on the rippability chart.

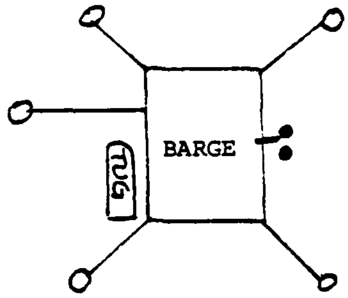
2. Relocation of oil dock to outer harbor.

Could be hazard to navigation due to ship traffic in harbor. More exposed to weather. Would require less rock removal. Would require extensive pipeline to storage tanks.

Are presently studying this alternative.

3. Multipoint buoy and buried pipeline offshore south of Whaler Island. Buoy system consists of five anchors with buoys and two additional buoys which are attached to the pump out mechanism. The barge,as maneuvered by the tug,would be attached to the five buoys. The pump mechanism would be powerful enough to pump out the barge within 6 hours. The pipeline from the shore storage area would be buried to a point near the buoys. The portion of the pipeline in the water would be flexible.

Pipeline could either go to shore near the storage tanks or to the pipeline at Whaler Island.



We are setting a wave guage south of Whaler Island to determine offshore conditions.

Need to determine ability of tug boat operators to maneuver barges into such a buoy system.

4. Blasting Rock - Removal with clamshell dredge.

Estimates were based on the need for 1.5 pounds of explosive per cubic yard of material to be removed. We have about 43,200 cy rock to be removed. The average depth of the rock is 4 foot. Based on the <u>Blasters Handbook</u>, we would need an 8 foot bore hole. We propose a 10 foot hole, 6 inches in diameter.

We have two extreme conditions that are presented below. These have numerous variations which could be implemented.

Estimates are based on: 4' x 4' pattern - holes are drilled on 4' centers

	Hours
Drill 12 holes requires	3.0
Load with charges	1.2
Move barge	3.0
Drill 12 holes	1.2
Load	
Move	
Detonate	0.4
	8 - 9 Hours

4' x 4' pattern

24 holes in 8 hours - all would be blasted at once.

Results in 85 lbs/8-hr day for 771 days

85 lbs/24 holes = 3.5 lbs/hole

The estimate is for working days only - no additional time has been included for inclement weather and traffic.

Variations: 24-hour blast cycle
(3 or 6 blasts per day)

2 barges - 170 lbs/8-hr day

In one 8-hour day - 2 blasts of 42.5 lbs each

Calculation for days required.

4' x 4' x 4' x 24 holes 56 cy/day

$$\frac{43200 \text{ cy}}{56 \text{ cy/day}} = 771 \text{ days}$$

For a 9' x 9' pattern - fewer holes - greater charge per hole.

9' x 9' 360 lbs/day for 180 day

Based on one blast of 20 holes/8 hour day

12 cy/hole x 1.5 lb/cy = 18 lbs/hole

Variations: 180 lbs twice a day

Blast on 24-hour cycle

Use 2 barges

DISPOSAL ALTERNATIVES

1. Land Disposal - The Crescent City Harbor District determined that no land sites are available.

2. Ocean Disposal - The Corps' EPA interim designated site has been proposed for ocean disposal. In fulfillment of Section 103 of PL 92-532, the Marine Protection, Research and Sanctuaries Act, a technical evaluation of the dredge material has been conducted. The Draft Report was submitted to the Corps on 13 November 1979. These were sent to the various agencies for their review on 16 November 1979. The results of the evaluation indicated no potential for adverse impact of the ocean dumping of dredge material from Crescent City Harbor, California.

The Corps is also conducting a site designation survey to finally designate the Crescent City Harbor Ocean Disposal Site. We have completed two field surveys. The draft findings of the first survey are found in the technical evaluation of dredged material. Results of the second field survey will be available in April 1980.

COORDINATION

1. 4 January 1979 the Corps described the proposed project to the U. S. Fish and Wildlife Service and requested information on the effects of blasting on the marine environment at Crescent City Harbor.

2. On 21 February 1979 USFWS provided a response to the above letter.

3. On 20 June 1979 the Corps requested a listing from the USFWS, Endangered Species Office, in accordance with Section 7 of PL 95-632, the Endangered Species Act Amendments of 1978.

4. On 31 August 1979 the Corps met with the USFWS on the transfer of funds coordination.

5. On 18 September 1979 we received a listing from the USFWS, Endangered Species Office.

6. Colonel Adsit and other Corps representatives met with representatives of the USFWS and the California Department of Fish and Game on 30 October 1979 to clarify the preliminary responses of these agencies in regard to blasting.

7. In a letter dated 13 November 1979, the USFWS restates their concerns.

NEED FOR PROJECT

Barge shipments of petroleum products dominate the current commerce of Crescent City Harbor.

Operation pattern: Petroleum products are barged from San Francisco to Crescent City. Before arriving at Crescent City the barge first stops at either Eureka or Coos Bay where cargo is partially off-loaded. On the average 42% of the total petroleum products shipped is off-loaded before continuing to Crescent City.

Actual split:

55% is off-loaded at Coos Bay

40% is off-loaded at Eureka

82% of Crescent City deliveries involves a stop at Eureka. With harbor deepening: (1) no longer need for off-loading and (2) eliminate tidal delays.

Average of 3 barges/month unload at Crescent City. 1979 a total of 39 barges stopped.

1. Review Dupont's <u>Blasters Handbook</u>, (requested by Steve Schultz, DFG).

Re: Submarine drilling -

a. Boreholes 2½ - 6" diameter

b. One rule is to have the bottoms of the boreholes same distance below grade as the spaces between holes.

c. Maximum spacing is on 10' centers.

d. Hi-Velocity Gelatin recommended - 60% grade is most common. In extremely hard rock 70% - 80% grade required.

e. Quantity of explosives necessary depends on -

hardness of material
depth of water
depth of boreholes

Softer rocks in shallow water - 1 lb/cy is sometimes sufficient.

Hard rock in deep water - 5 lbs/cy or more may be required - although average is 2 - 3 lbs/cy.

2. Anticipated shock wave factor or velocity:

Equation developed by Dr. A. J. Hendron, Jr. of University of Illinois at Champaign.

$$V = 360 \text{ in/sec} \left(\frac{R}{W^{1/3}}\right)^{-1.6}$$

Where V = peak particle velocity in in/sec

R = range in feet

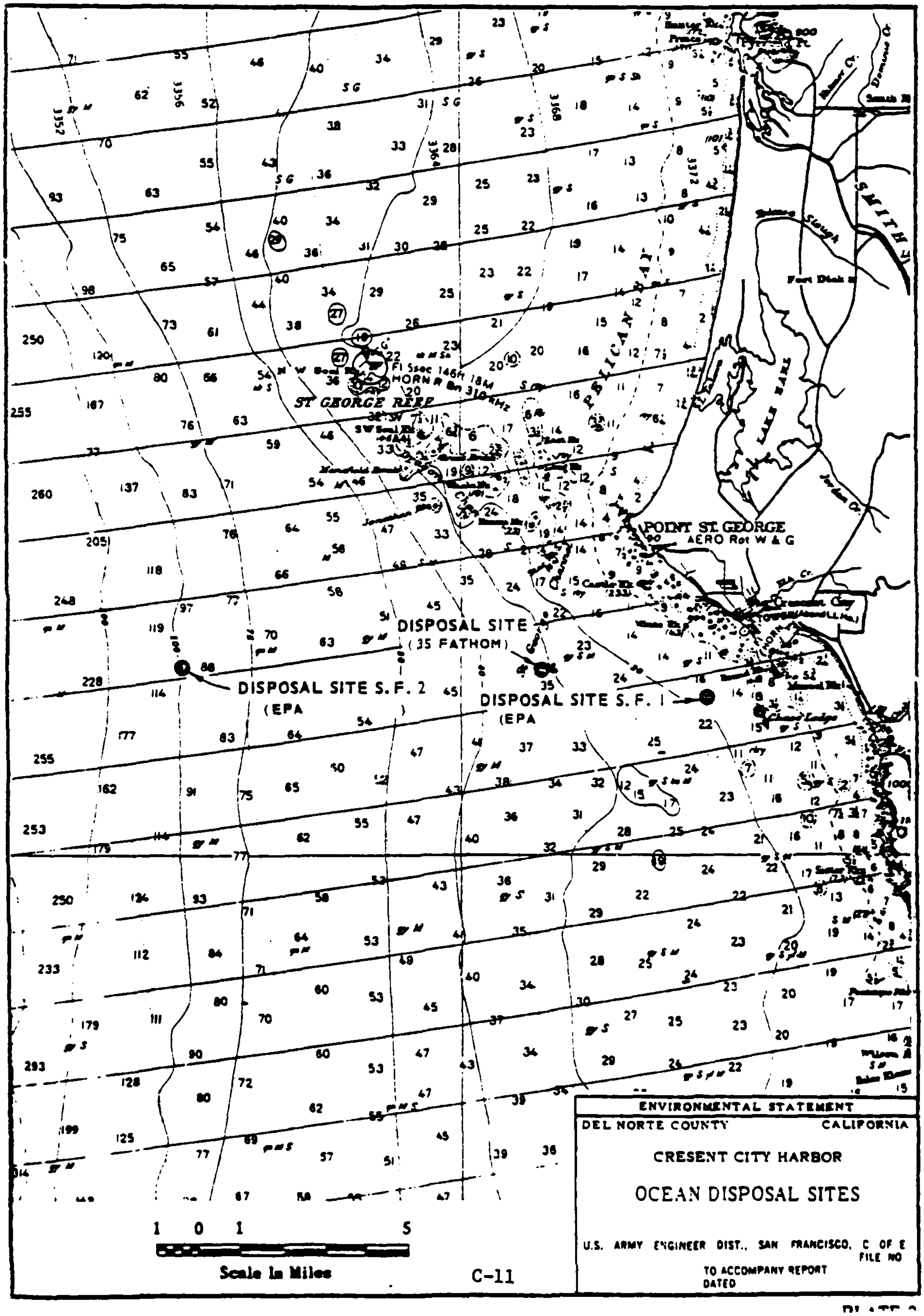
W = Weight of explosive in pounds

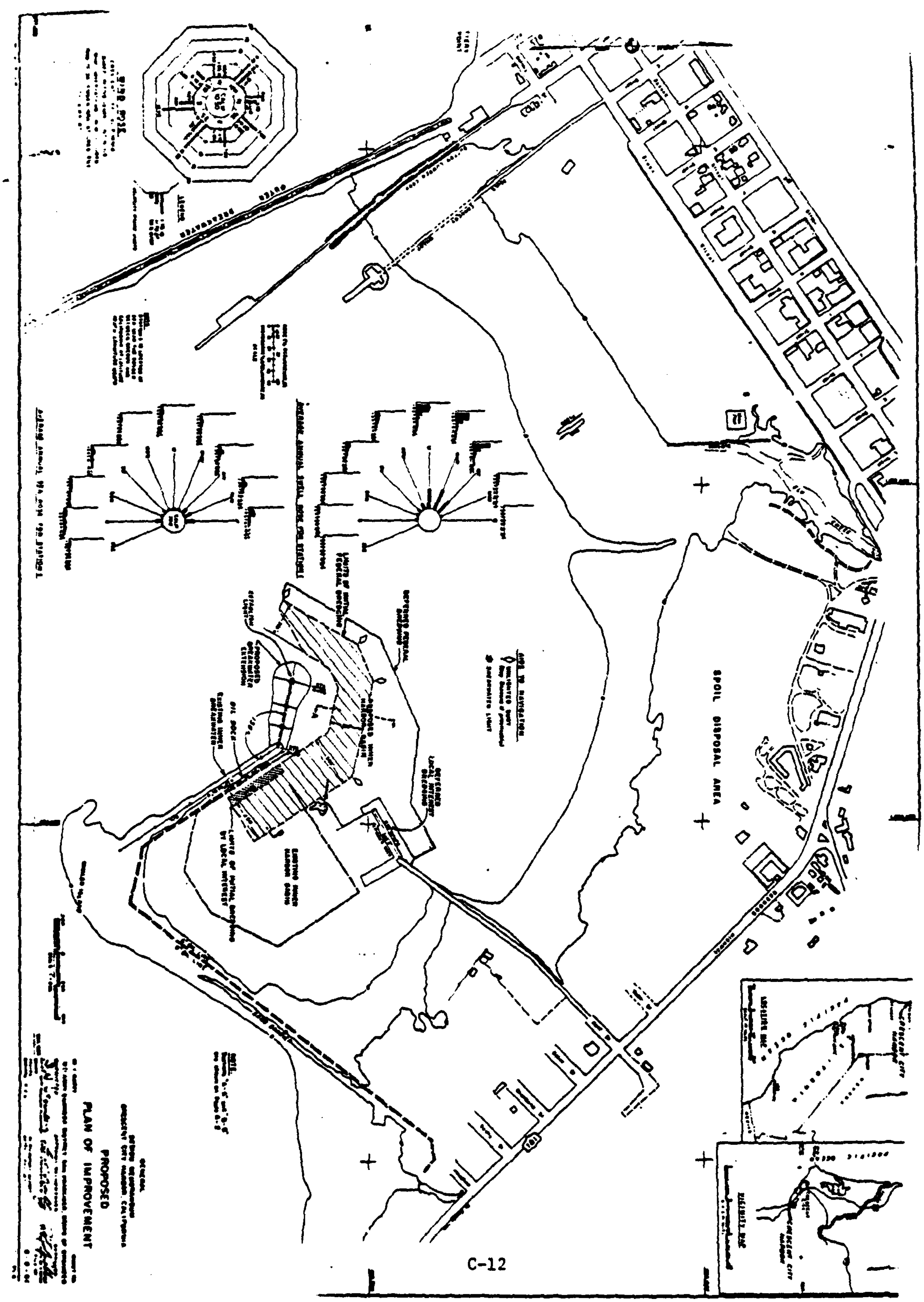
Using a worst case approach:

24 charges weighing 9 lb. each, a total of 216 lb of 75% ammonium nitrate, 25% dynamite gel -

We have the following:

Range (In feet)	V, in/sec	Duration	Predominant Frequency
50	0.96	$<$ 1 sec	10 - 20 Hz
100	0.32	$<$ 1 sec	10 - 20 Hz
200	0.10	$<$ 1 sec	5 - 15 Hz
300	0.20	$<$ 2 sec	5 - 10 Hz


POINT ST. GEORGE
AERO Rot W & G
ST GEORGE REEF
PELICAN BAY
LAKE EARL
SMITH R
Crescent City
DISPOSAL SITE
(35 FATHOM)
DISPOSAL SITE S.F. 2
(EPA)
DISPOSAL SITE S.F. 1
(EPA)
1 0 1 5
Scale in Miles
ENVIRONMENTAL STATEMENT
DEL NORTE COUNTY CALIFORNIA
CRESENT CITY HARBOR
OCEAN DISPOSAL SITES
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO
TO ACCOMPANY REPORT
DATED



SPOIL DISPOSAL AREA
PROPOSED
PLAN OF IMPROVEMENT

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Area Office
2800 Cottage Way, Room E-2740
Sacramento, California

MAY 28 1981

In reply refer to ES-S

District Engineer
San Francisco District, Corps of Engineers
211 Main Street
San Francisco, California 94105

Dear Sir:

Attached is our detailed report on the effects that proposals to deepen Crescent City Harbor and entrance channel will have on biological resources and use thereof in the project area at Crescent City, Del Norte County, California. It has been prepared under the authority, and in accordance with the provisions, of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; U.S.C. 661 et seq.). The biological information presented in this report was developed in cooperation with the California Department of Fish and Game, the National Marine Fisheries Service, and the Corps of Engineers, San Francisco District. The report has received the concurrence of the California Department of Fish and Game as indicated in the attached letter of January 27, 1981, signed by Director E. C. Fullerton. It has also been reviewed by the National Marine Fisheries Service.

Our report is based on planning information provided by the Corps of Engineers prior to January 1, 1981, on an appraisal of existing resources, and on projections of the future using current information. The analysis contained in this report will not remain valid if modifications are made in the described project plan and method of construction, or if the resource base and/or harvesting mode changes, or if anticipated futures are altered.

The Fish and Wildlife Service can support the Corps of Engineers recommended plan for navigation improvement at Crescent City contingent upon the Corps' adoption of the following recommendations:

1. That the authorized plan, as modified, is selected;

2. That construction is accomplished between August 1 and November 1;

3. That dredging in the harbor entrance is coordinated with the harbor-master to minimize boat access problems for fishermen.

Should blasting be required to remove any presently undetected rock formations, the Fish and Wildlife Service and California Department of Fish and Game should be informed so that they may participate in planning and monitoring this activity as required.

Should additional consideration be given to the development of a marine terminal at Crescent City Harbor, the Service suggests that use of the oil dock location be evaluated as an alternative to construction of another such facility within the harbor.

Please notify us of your actions regarding our recommendations.

Sincerely yours,

ACTING Area Manager

cc: Dir., CDF&G, Sacramento
CDF&G, Eureka
NMFS, Tiburon

Attachment

STATE OF CALIFORNIA—RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
SACRAMENTO, CALIFORNIA 95814
( ) 445-3535

January 27, 1981

Mr. William D. Sweeney
Area Manager
U.S. Fish and Wildlife Service
2800 Cottage Way - Room E-2740
Sacramento, California 95825

Dear ~~Mr. Sweeney~~: Bill

Personnel of the Department of Fish and Game have reviewed your detailed report on plans developed by the San Francisco District, U.S. Army Corps of Engineers for the deepening of Crescent City Inner Harbor and a portion of its entrance channel, Crescent City, Del Norte County, California. We concur with your recommendations.

Sincerely,

Chas

Director

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

CRESCENT CITY HARBOR PROJECT
CALIFORNIA

A DETAILED REPORT ON

FISH AND WILDLIFE RESOURCES

REGION ONE

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Area Office
Sacramento, California

A DETAILED REPORT

ON THE

CRESCENT CITY HARBOR PROJECT

May 1981

TABLE OF CONTENTS

PREFACE

The Corps of Engineers' investigation of Crescent City Harbor was authorized by the River and Harbor Act of 1965. Elements evaluated in this study include deepening the inner harbor and entrance channel. We have been notified by the Corps of Engineers that blasting for rock removal in the inner harbor is no longer being considered since core sampling has shown that the harbor can be deepened by using conventional dredging methods. The Service's previous actions on this project, as presently proposed, included provision of a planning aid letter on February 21, 1979.

DESCRIPTION OF THE AREA

The area under investigation, located in Del Norte County, California, is situated on the coast approximately 17 miles south of the Oregon border. A small intermittent stream, Elk Creek, empties into the 450-acre harbor.

Commercial use of Crescent City Harbor includes berthing of commercial and sport fishing vessels, harvest of herring, and barge traffic for oil import. Recreational boats are also moored within the harbor. The harbor provides sportfishing and shellfishing opportunities for local citizens.

The principal aim of the proposed navigation improvements is to facilitate the navigation of fully loaded oil barges. At this time oil shipments to Crescent City are made by barges which must be partially offloaded at Eureka or Coos Bay because of the relatively shallow depths in Crescent City Harbor and its entrance channel. The harbor is subject to surge problems which adversely affect vessel loading and mooring on a periodic basis. In addition, several tsunami waves have struck the harbor, some of which caused significant damage to docking facilities and commercial fishing boats. Shoaling, attributed to longshore sediment transport, occurs within the harbor and entrance channel.

The lumber industry is no longer using Crescent City Harbor. However, plans to expand commercial harbor facilities have been proposed to accommodate potential development of a fishing industry for presently underutilized species and of chromium mining in the Smith River watershed. These plans do not include use of the oil dock area at this time.

DESCRIPTION OF THE PROJECT

The Crescent City Harbor project has been designed for a 50-year project life. Two proposals are being considered to effect navigation improvements (Fig. 1).

The authorized project, as modified, has been designated as the recommended plan by the Corps of Engineers. This project would require dredging of approximately 138,000 cubic yards of sand and shale from a 9.7-acre area within the inner harbor to achieve a depth of -20 feet MLLW. In addition, approximately 20,000 cubic yards of material, primarily sand, would be removed from the entrance channel in an area about 330 feet by 475 feet (3.8 acres).

An alternative would require relocation of the inner harbor oil dock to the inner side of the inner breakwater. Approximately 84,000 cubic yards would be dredged from an 8.2-acre area to reach a depth of -20 feet MLLW and allow access to the relocated dock facilities. The entrance channel would also be dredged, as previously described, if this proposal were pursued.

The channel and inner harbor would be deepened by using a mechanical dredge. All dredged material would be transported via hopper barge to an Environmental Protection Agency interim-approved disposal site located approximately 1.3 miles offshore at 124 12' 00" west longitude and 41 43' 15" north latitude. The disposal site covers an area of approximately 0.25 square miles. It is anticipated that material obtained during maintenance dredging operations will be disposed offshore.

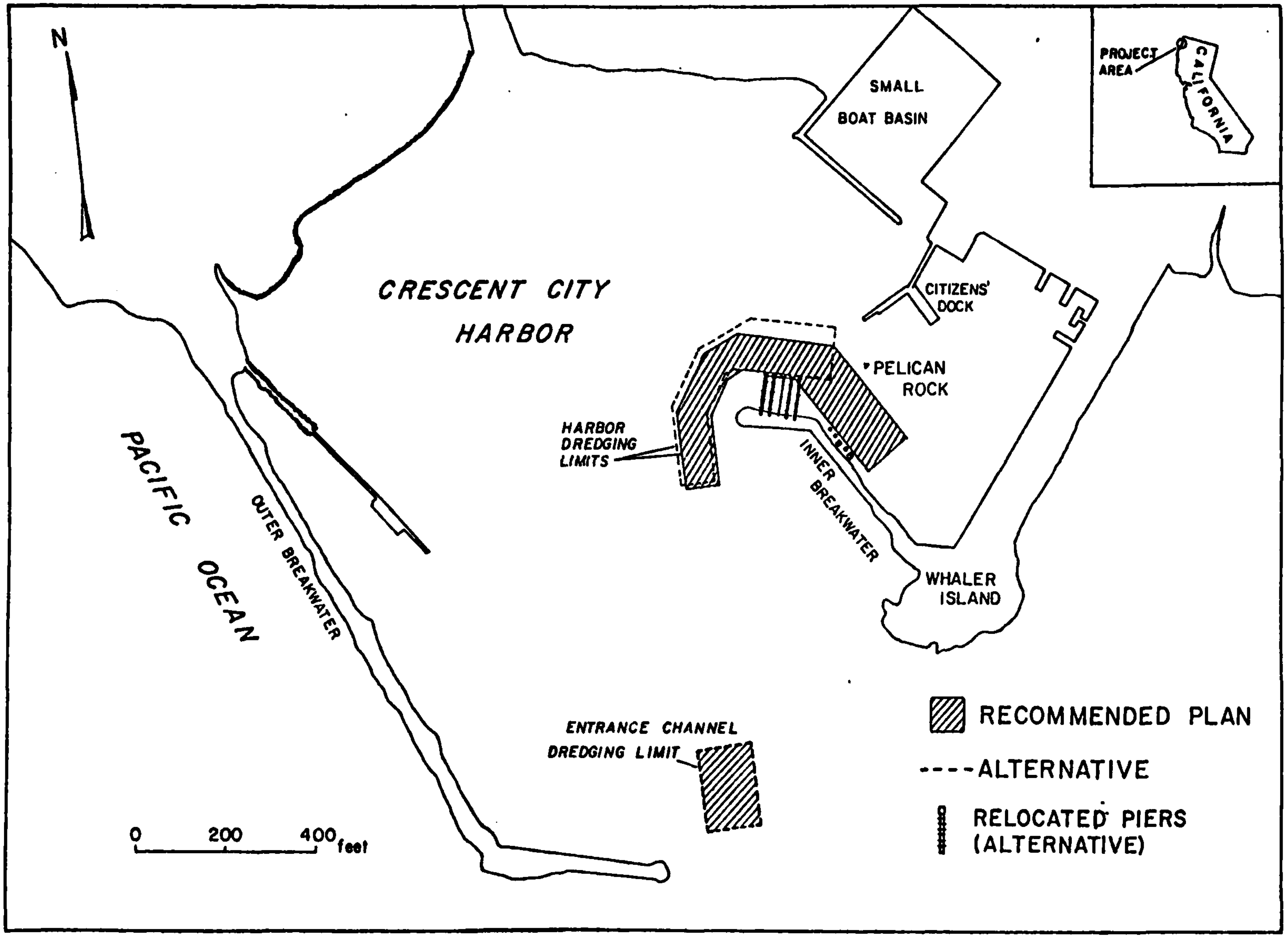


Figure 1. Location of alternatives proposed by the U.S. Army Corps of Engineers for navigation improvement at Crescent City Harbor, Crescent City, Del Norte County, California.

Another proposal, construction of an offshore oil terminal, has been eliminated from further study. This alternative would have required bottom placement of an oil line either going directly to the onshore tank farm or tying into the existing oil line running from the present oil terminal to the tank farm. This proposal is ineligible for Federal funding.

BIOLOGICAL RESOURCES

Marine Resources

The harbor and proposed offshore disposal site are utilized by a variety of marine fish and shellfish resources. Herring harvested commercially within the harbor, from January through March, have an estimated final market value of $100,000 annually at current prices. The protected waters of the harbor are also habitat for juvenile Dungeness crabs, with the largest concentrations occurring in the vicinity of Citizens Dock and Fishboat Harbor. The harbor also supports a winter sport fishery. Adult Dungeness crabs which seasonally move inshore to molt and spawn are taken both in and near the harbor. Several fish species including jacksmelt (*Atherinopsis californiensis*), black rockfish (*Sebastes mystinus*), lingcod (*Ophiodon elongatus*), and red rockfish (*Sebastes* spp.) provide additional sportfishing opportunities within the harbor. Young of these and other fish frequent the shallow rocky shores and breakwaters as well as the kelp beds located along the western edge of Whaler Island and south of the harbor.

In addition to these resources, the sandy flats along the harbor shoreline have shellfish beds which are harvested by local residents. A large razor clam bed is located along the sandy shoreline south of the harbor.

Elk Creek historically supported small spawning runs of steelhead trout, silver salmon, and cutthroat trout. However, lumber harvest practices have significantly reduced these runs. Logging debris which also collects along the harbor shoreline east of Elk Creek has reduced shellfish use of this area.

Physiochemical and biological sampling done at the proposed disposal site during June 1979 showed that a sharp thermocline occurred between 25 and 40 feet. Current speeds averaging 0.8 ft/sec at the surface exceeded those recorded for the deeper water mass, which averaged 0.1 ft/sec near the bottom. Oxygen concentrations also exhibited a gradual decline from an average of 10 mg/l at the well-mixed surface to a mean of 2.2 mg/l at 82 feet.

The polychaete worm (Owenia collaris) and the gastropod (Olivella pycna) constituted the greatest abundance of benthic animals found at the disposal site. The most abundant epibenthic organisms, collected by otter trawl, included the Dungeness crab (Cancer magister), Pacific tomcod (Microgadus proximus), night smelt (Spirinchus starksi), and yellowtail rockfish (Sebastes flavidus). Dungeness crab, night smelt, and yellowtail rockfish have commercial value for the dining market. The Pacific tomcod has a minor importance as a sportfish.

Since commercial otter trawling is prohibited within the 3-mile limit, fishing in and around the proposed disposal site is limited to crabbing, sportfishing, and commercial fishing for salmon. In 1975 less than 0.5 percent of the State's market crab landings was taken from the delineated 100 square mile fish block in which this 0.25 square mile site is located.

Offshore sportfishing for silver and chinook salmon primarily occurs in a 44-square mile band found west of Crescent City in which the disposal site is located. In addition to these species, rockfish, lingcod, kelp greenling, cabezon, and Pacific halibut are taken by sport fishermen along Chase Ledge and in a nearshore band south of Crescent City.

Wildlife Resources

Both migratory and resident coastal birds are found in the project area. Seabirds feeding in and around the harbor include Leach's petrel (Oceanodroma leucorhoa), fork-tailed petrel (O. furcata), Cassin's auklet (Ptychoramphus aleuticus), rhinoceros auklet (Cerorhinca monocerata), tufted puffin (Lunda cirrhata), common

murre (Uria aalge), western gull (Larus occidentalis), black oyster catcher (Haematopus bachmani), pelagic cormorant (Phalacrocorax pelagicus), and Brandt's cormorant (P. penicillatus). In addition, the endangered Aleutian Canada goose (Branta canadensis leucopareia), American peregrine falcon (Falco peregrinus anatum), and California brown pelican (Pelicanus occidentalis californicus) are seen within the project vicinity. Aleutian Canada geese migrate through the Crescent City area, roosting on Castle Rock at night and feeding in the pastures north of the Del Norte County Airport as they collect in flocks prior to flying to their breeding areas. The California brown pelican, also a migratory visitor, feeds both offshore and in the harbor, and roosts on harbor breakwaters and jetties as well as Pelican Rock. As many as 50 birds have been seen at one time in the harbor area between May and November, with the largest concentrations occurring between June and September. From 10 to 15 pelicans have been sighted together on Pelican Rock. Several species of marine mammals including the harbor seal (Phoca vitulina), Stellar's sea lion (Eumetopias jubata), California sea lion (Zalophus californianus), and whales frequent the project area. Harbor seals have been sighted within Crescent City Harbor. In addition, whales historically occurring in the area offshore of Crescent City include the following endangered species: the gray whale (Eschrichtius robustus), blue whale (Balaenoptera musculus), finback whale (B. physalus), sei whale (B. borealis), right whale (B. glacialis), sperm whale (Physeter catodon), and humpback whale (Megaptera novaeangliae). While the majority of large cetaceans are found primarily in California's distant offshore waters, small groups of migrating gray whales are frequently seen within a few hundred yards of shore where they provide a unique experience for a growing number of whale watchers. The gray whale migrates south in the winter, particularly from December through February, to breeding and calving grounds in small lagoons along the coast of Mexico. In the spring, primarily during March and April, they move northward to their feeding grounds in the western Berring Sea and adjacent Arctic Ocean.

The primary periods of use of the harbor and disposal site by marine resources and wildlife, and commercial and sport fishermen are illustrated in Figure 2.

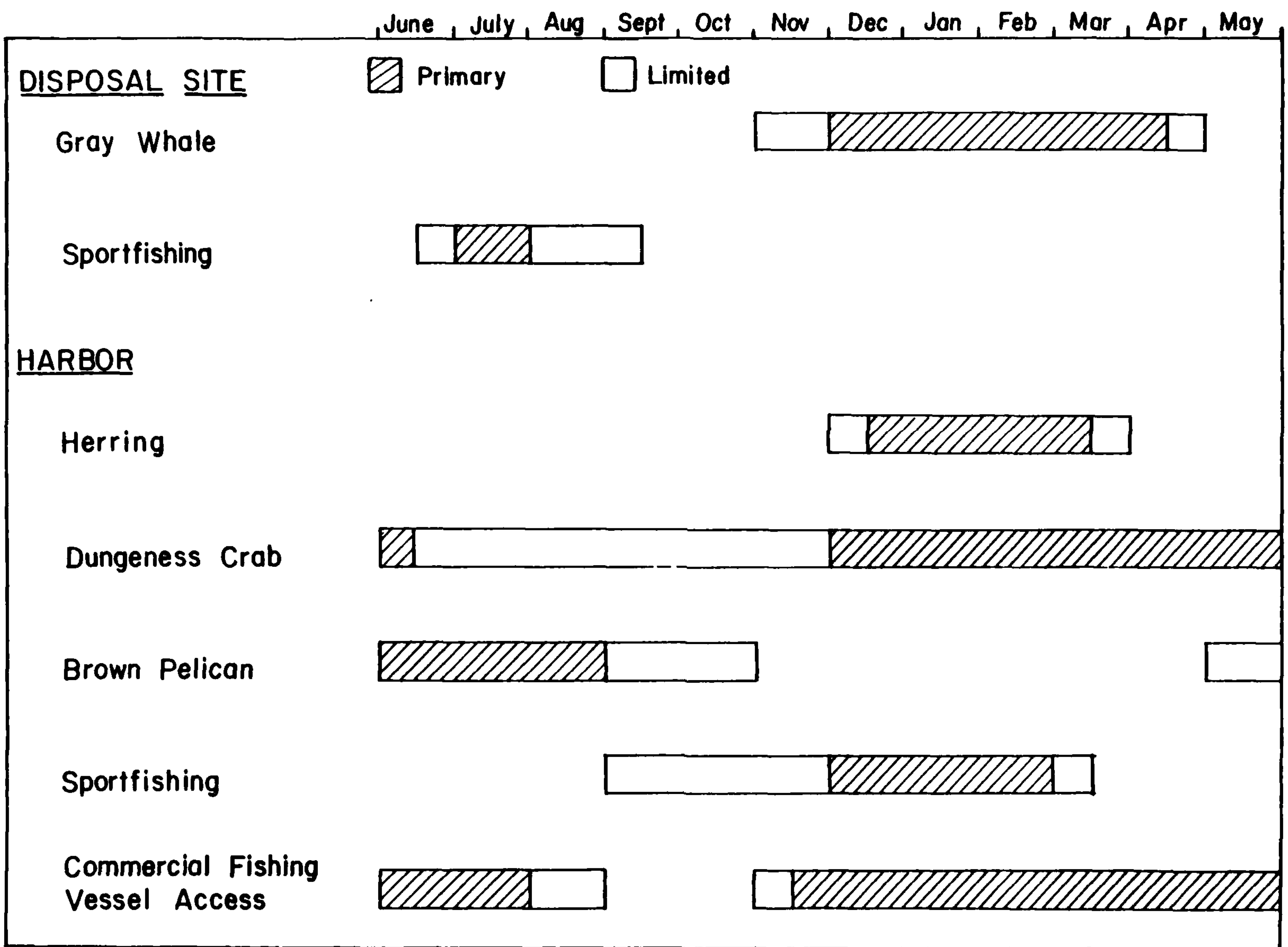


Figure 2. Periods of use of the disposal site and harbor by wildlife, marine resources, and fishermen.

Restricted to land, the rocky coast snail (Monadenia fidelis pronotis), a candidate for threatened status, has been found on moist coastal terraces at Point St. George, north of Crescent City. Thurber's reed grass (Calamagrostis crassiglumus Thurb.), a terrestrial plant and candidate for threatened status, has been collected in isolated freshwater marshes and swampy areas along the coast from Alaska south to Mendocino County, California. It was not reported as occurring in the Crescent City Harbor periphery during a recent field survey, but may be found in the wetland to the south.

DISCUSSION OF PROJECT IMPACTS

Construction of either alternative plan would reduce the number of barge trips now occurring, as well as hookups for loading and unloading fuel which frequently result in accidental oil spills.

Construction impacts are similar in type and scope for the recommended plan and its alternative (which would require relocation of the oil dock). Approximately 3 percent and 2.7 percent of the harbor area, respectively, would be deepened with implementation of these alternatives. However, the area which would be impacted by the recommended plan has been disturbed by previous dredging. Implementation of this plan would not require relocation of the docking facilities and the attendant disturbance to the biota using the shoreline.

Short-term adverse impacts associated with dredging and disposal operations include destruction of sessile and slow-moving benthic and epibenthic organisms at the work site and the smothering of such species at the disposal site. Both dredge and disposal sites would probably be repopulated within a short period with the same species lost during project construction. Migrant fish and shellfish would not be significantly affected providing the work was not undertaken during their primary periods of use of the dredge and/or disposal sites. Less than 0.6 percent of

the offshore area most heavily used by sport fishermen and less than 0.002 percent of the 100-square-mile fish block in which the disposal site is located would be directly impacted by disposal activities. Reduction in oxygen levels resulting from disposal activities should be minimal within the epibenthic zone and should not result in a significant adverse biological impact on a long-term basis. Based on bioassays, long-term degradation of water quality resulting from heavy metal and hydrocarbon release is not anticipated at the disposal site.

Displaced sedentary organisms at the dredge and disposal sites would provide food for more mobile species. Similarly, if any fish were killed at the dredge or disposal sites, they too would provide a food source for other marine organisms as well as seabirds and the endangered California brown pelican.

Adverse impacts on commercial and recreational marine resources would be minimized if project construction were undertaken between August and November. Dungeness crab juveniles found in the harbor and offshore disposal site would generally be large enough to escape both dredge and disposal operations during this period. Conflicts during herring harvest would also be avoided. In addition, disturbance to shore fishermen using the harbor and interruptions in sport and commercial fishing boat traffic would be minimized if construction and maintenance of the proposed project were accomplished during this period. In addition, the principal harbor use period by local sport fishermen and by commercial and recreational fishermen using boats would be avoided. Dredging in the boat traffic lanes in the entrance channel and harbor area should be coordinated with the harbor master to minimize this impact further.

It appears that disturbance to the California brown pelicans using the harbor would be minimal and limited to the construction and maintenance dredging periods. Disposal operations are not expected to affect the endangered gray whale population if done between August and November. Use of the disposal site should be temporarily halted, however, at any time whales are observed in the immediate vicinity. Since the navigation improvement alternatives have been designed to facilitate shipment of oil to Crescent City at no more than the present rate of

need, secondary impacts from increased growth within the service area are not anticipated at this time. Therefore, the project is not expected to affect the rocky coast snail, or Thurber's reed grass, candidates for threatened status. In addition, the project probably would not affect the endangered American peregrine falcon or the endangered Aleutian Canada goose, both of which may occasionally be seen flying in the harbor vicinity. Adverse impacts associated with maintenance dredging would occur under without- and with-the-project conditions. However, these impacts can be reduced if the dredging and disposal are timed to avoid critical periods of use of both the harbor and disposal site by marine resources, the gray whale and fishermen.

The amount of benthic disturbance resulting from construction of an offshore terminal would probably be considerably less than from the two alternatives requiring harbor deepening. However, if the oil line were extended through biologically important kelp beds, adverse impacts (though short-term) could be severe. In addition, surge conditions in the harbor vicinity could result in oil spills incidental to hookups or from vessel damage. Equipment is presently available to contain oil spills occurring within the harbor, but would have to be imported if an open ocean spill occurred. Spills of any magnitude at this location could adversely impact valuable marine fish and shellfish and their habitats, marine birds including the endangered California brown pelican, and marine mammals including the endangered gray whale.

In summary, adverse biological impacts associated with the proposed project could be minimized by selecting the recommended plan. These impacts could be further reduced by performing construction and maintenance activities between August and November when use of the harbor and openwater disposal site by marine resources and sport and commercial fishermen is at a minimum.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
AREA OFFICE
2800 Cottage Way, Room E-2740
Sacramento, California 95814

MAY 0 4 1981

Mr. Jay K. Soper
Department of the Army
San Francisco District
Corps Of Engineers
211 Main Street
San Francisco, California 94105

Subject: Crescent City Harbor Navigation Project

Dear Mr. Soper:

In reponse to your letter of April 20, 1981, the species list we provided (dated September 18, 1979) on the subject project is still valid except for one change. The rocky coast snail, Monadenia fidelis pronotis, is no longer an officially proposed species. It is considered a candidate species by our Service and may be treated in your Biological Assessment at your option.

Mr. Swanson (FTS 448-2791) can assist you with any other questions you may have on this matter.

Sincerely yours,

Area Manager

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Room E-2727
Sacramento, California 95825

MAY 07 1981

District Engineer
San Francisco District, Corps of Engineers
211 Main Street
San Francisco, California 94105

Dear Sir:

The following information is provided as technical assistance to the U.S. Army Corps of Engineers, San Francisco District, for its compliance with Section 7 of the Endangered Species Act of 1973, as amended, with regard to the proposed Crescent City Harbor project.

Data on the distribution, habitat requirements, condition of the population in the study area and probable impacts associated with project construction and maintenance are included for the endangered California brown pelican (Pelicanus occidentalis californicus), American peregrine falcon (Falco peregrinus anatum), Aleutian Canada goose (Branta canadensis leucopareia), and gray whale (Eschrichtius robustus). Information is also included for the rocky coast snail (Monadenia fidelis pronotis) and Thurber's reed grass (Calamagrostis crassiglumis Thurb.) which are candidates for Federal designation as threatened. Knowledgeable individuals were contacted and a review of pertinent literature was conducted to determine species abundance and distribution and to gather information on life history.

Several other endangered whales have been sighted off the California Coast including the blue whale (Balaenoptera musculus), finback whale (B. physalus), sei whale (B. borealis), right whale (B. glacialis), sperm whale (Physeter catodon) and humpback whale (Megaptera novaeangliae). However, it is extremely unlikely that they would be found as near to shore as the preferred disposal site for the Crescent City Harbor project. Therefore, information on these species is not included in this report.

STUDY AREA

Improvement of Crescent City Harbor was authorized by the River and Harbor Act of 1965. Elements evaluated in this study include deepening the inner harbor and entrance channel. We have been notified by the Corps of Engineers that blasting for rock removal in the inner harbor is no longer being considered since core sampling has shown that it can be deepened by using conventional dredging methods.

The area under investigation, located in Del Norte County, California, is situated on the coast approximately 17 miles south of the Oregon border. A small intermittent stream, Elk Creek, empties into the 450-acre harbor.

Commerical use of Crescent City Harbor includes berthing of commercial and sport fishing vessels, harvest of herring, and barge traffic for oil import. Recreational boats are also moored within the harbor. The harbor provides sport fishing and shell fishing opportunities for local citizens.

The principal aim of the proposed navigation improvements is to facilitate the navigation of fully loaded oil barges which at present must be partially offloaded at Eureka or Coos Bay because of the relatively shallow depths in Crescent City Harbor and its entrance channel. The project is not expected to result in growth in population or industry in the Crescent City area. The harbor is subject to surge problems which adversely affect vessel loading and mooring on a periodic basis. In addition, several tsunami waves have struck the harbor, some of which caused significant damage to docking facilities and commercial fishing boats. Shoaling, attributed to longshore sediment transport, occurs within the harbor and entrance channel.

The lumber industry is no longer using Crescent City Harbor. However, plans to expand commercial harbor facilities have been proposed to accommodate potential development of a fishing industry for presently underutilized species and of chromium mining in the Smith River watershed. These plans do not include use of the oil dock area at this time.

PROJECT DESCRIPTION

The Crescent City Harbor project has been designed for a 50-year project life. Two proposals are being considered to effect navigation improvements (Fig. 1).

The authorized project, as modified, has been designated as the recommended plan by the Corps of Engineers. This project would require dredging of approximately 138,000 cubic yards of sand and shale from a 9.7-acre area within the inner harbor to achieve a depth of -20 feet MLLW. In addition, approximately 20,000 cubic yards of material, primarily sand, would be removed from the entrance channel in an area about 330 feet by 475 feet (3.8 acres).

An alternative would require relocation of the inner harbor oil dock to the upper arm of the inner breakwater. Approximately 84,000 cubic yards would be dredged from a 8.2-acre area to achieve a depth of -20 feet MLLW and allow access to relocated dock facilities. The entrance channel would also be dredged, as previously described, if this proposal were pursued.

The channel and inner harbor would be deepened by using a mechanical dredge. All dredged material would be transported via hopper barge to an Environmental Protection Agency interim-approved disposal site located approximately 1.3 miles offshore at 124 12' 00" west longitude and 41 43' 15" north latitude. The disposal site covers an area of approximately 0.25 square miles. It is anticipated that material obtained during maintenance dredging operations will be disposed offshore.

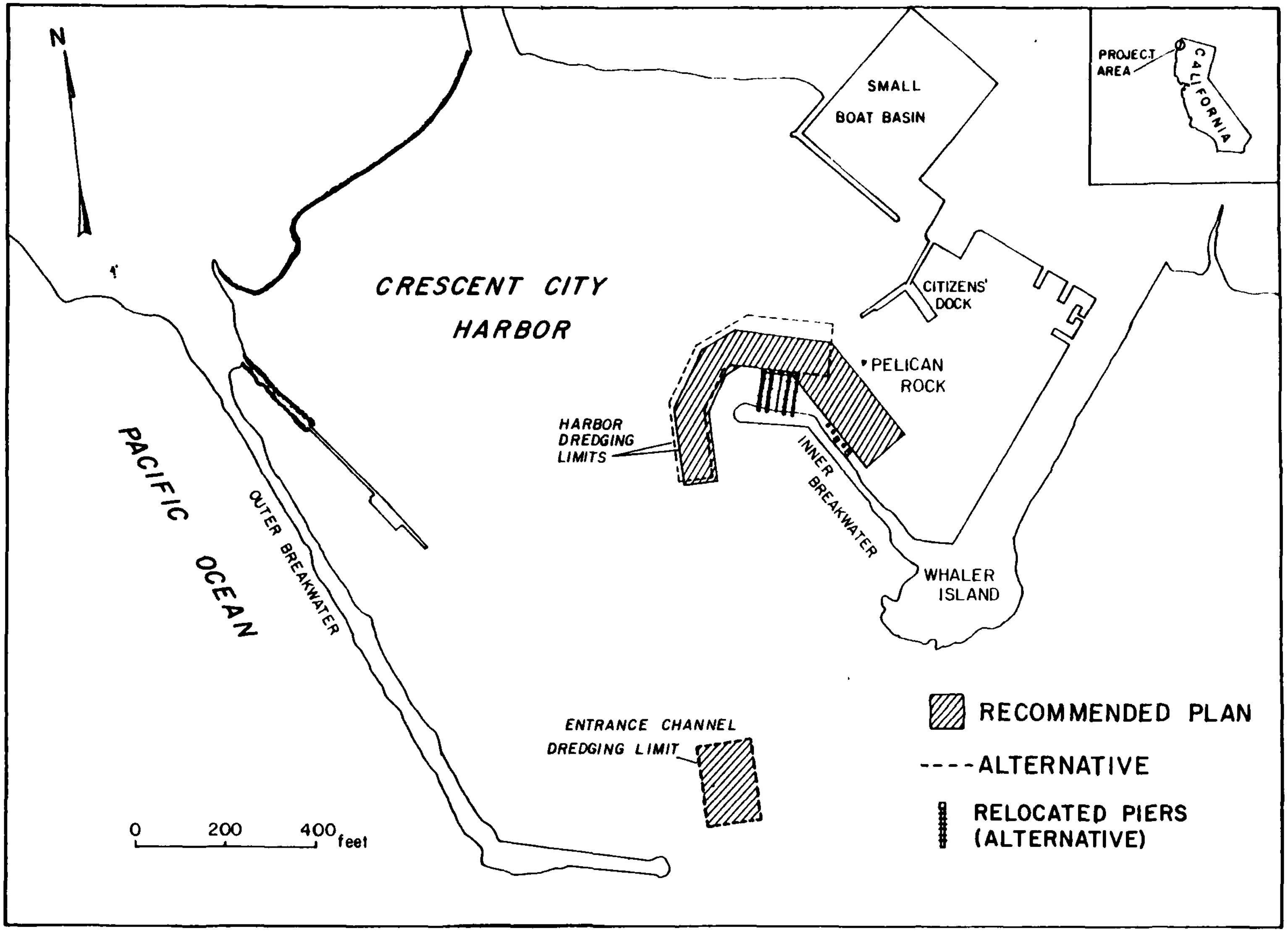


Figure 1. Location of alternatives proposed by the U.S. Army Corps of Engineers for navigation improvement at Crescent City Harbor, Crescent City, Del Norte County, California.

Another proposal, construction of an offshore oil terminal, has been eliminated from further study. This alternative would have required bottom placement of an oil line either going directly to the onshore tank farm or tying into the existing oil line running from the present oil terminal to the tank farm. This proposal is ineligible for Federal funding.

ENDANGERED SPECIES

California Brown Pelican

Distribution:

The brown pelican occurs on the Pacific Coast from Canada to Mexico. In California, breeding occurs on the Channel Islands; in Mexico, on coastal islands off Baja California and in the Gulf of California. A 1972 survey indicated that the total population approximates 100,000 birds with 20,000 frequenting the California Coast from August through November. Brown pelicans are fall visitors to the Crescent City Harbor area. As many as 50 pelicans have been sighted in the vicinity, with 10-15 roosting at one time on Pelican Rock.

Habitat Requirements:

The habitat of the brown pelican includes the open sea, coast, large bays, estuaries, harbors, and breakwaters. Typically, pelicans roost at night on offshore islands, coastal cliffs, mainland beaches, promontories, and breakwaters, and spend daylight hours searching for food in waters fairly close to land. They are plunge-divers, preying on small fish near the water's edge.

As noted above, breeding occurs on the Channel Islands and on coastal islands off Baja California and in the Gulf of California. Nests are constructed primarily on steep, rockly slopes. Reproductive failure is a factor limiting population size. Recent observations indicate that food stress at the nesting site is resulting in nest abandonment early in the season. Earlier findings attributed reproductive failure to thin eggshells which collapsed during incubation.

Condition of Population in Study Area:

Since the species is only a fall visitor, the importance of the project area to the overall population is difficult to assess. Barring pollution or other man-caused problems resulting in a significant reduction in biological productivity, the project area should continue to be utilized by brown pelicans.

American Peregrine Falcon

Distribution:

Historically, the American peregrine falcon was distributed throughout much of North America. Prior to recent recovery efforts, the species was extinct as a breeding bird east of the Rocky Mountains. In 1946, 100 pairs of peregrine falcons

were believed to be in California; however, in a 1970 census only 10 birds were recorded. They may occasionally be sighted flying over the study area.

Habitat Requirements:

The peregrine is seen in open country from the mountains to coastal areas within its range. It feeds on passerine birds, waterfowl, and shorebirds.

The reasons for its decline have been attributed to the cumulative effects of pesticides contained in the tissues of its prey (causing a loss in reproductive success when thin egg shells collapse during incubation); human interference with nesting; capture by falconers; and shooting. In California, critical habitat designated for this species is located in Napa and Sonoma Counties, more than 300 miles to the south of the project area.

Condition of Population in Study Area:

The American peregrine falcon is only an occasional visitor to the study area, probably during migration.

Gray Whale

Distribution:

In the eastern Pacific, gray whales are found from the Arctic Ocean southward along the North American coast to the Gulf of California. In 1971, estimates of the number frequenting the California Coast ranged from 6000-8000, less than 25% of the calculated historical population.

Habitat Requirements:

The gray whale, a baleen cetacean, feeds on small crustaceans (krill). It is believed that feeding takes place primarily during the four months of the year they spend in the north.

Southward migration takes place in the winter, particularly in December though February, when groups of two to five may be seen off the coast. In the bays and lagoons of their southern range extension, females have their calves and breed. Northward migration occurs primarily in March and April. Migrating whales travel close to shore, frequently coming within a few hundred yards of the shore or, in some cases, into the surf zone.

Condition of the Population in the Study Area:

Gray whales travel in the vicinity of the disposal area during their winter and spring migration periods. Since their migratory corridor near Crescent City is broad, the areal importance of the proposed disposal site appears negligible.

Aleutian Canada Goose

Distribution:

The Aleutian Canada goose once nested in the outer two-thirds of the Aleutian Islands, and its winter range may have stretched from British Columbia as far south as Mexico. Today, the only remaining breeding population of the Aleutian Canada goose is found on Buldir Island in the Aleutian chain. The species now winters in the Central Valley of California from near Colusa in the north to the vicinity of Los Banos in the south. In 1979, the total population of the Aleutian Canada goose was estimated at 1,750. During migration the geese stop and roost on Castle Rock, located about 3 miles north of Crescent City Harbor and approximately 0.6 miles offshore, and feed in nearby pastures on the mainland. In 1976-1977, the entire population of this species was believed to have used Castle Rock as a spring staging area. Aleutian Canada geese are not known to utilize Crescent City Harbor but may fly over the harbor during migration.

Habitat Requirements:

The habitat of the Aleutian Canada goose includes pastures, wetlands, meadows, agricultural fields, and ocean islands. The geese forage in meadows and/or pastures during the day and roost on an island or on a pond at night. In the Central Valley, Aleutian Canada geese feed on waste grain and beans, and vegetative parts of many marsh plants. In the Crescent City area, the geese roost on Castle Rock and fly to the mainland to feed in pastures at Reservation Ranch near the Del Norte County Airport.

Condition of the Population in Study Area:

Aleutian Canada geese utilize Castle Rock during the fall and spring migration periods. Numbers of the geese seen at Castle Rock in the spring have shown significant increases from 1975 to 1977. This offshore island appears to be an important spring staging area for this species. The pastures utilized by the geese on Reservation Ranch are becoming overgrown with rank vegetation. Therefore, there has been an increase in the use of Bliss Ranch by the birds, a site frequently hit with avian cholera outbreaks in the spring. Castle Rock is being proposed for inclusion into the National Wildlife Refuge System and 930 acres near the airport have been proposed for leasing.

CANDIDATE SPECIES

Thurber's Reed Grass (candidate for threatened status)

Distribution:

Thurber's reed grass occurs in apparently disjunct populations along the west coast of North America from Alaska south to Mendocino County, California. In California it has been reported as occurring in the vicinity of Point Arena.

Habitat Requirements:

This plant is found in freshwater marshes and swampy areas along the Pacific Coast. It flowers in June-July.

Condition of Population in Study:

This plant was not found during a 1979 botanical survey in the harbor area. However, it may occur in the freshwater wetland east of Highway 101 located just south of Crescent City.

Rocky Coast Snail (candidate for threatened status)

Distribution:

This small, variably colored land snail is known only to occur at Point St. George, located north of Crescent City.

Habitat Requirements:

The rocky coast snail is found in rocky, moist habitat vegetated with *Mesembryanthemum* and other seashore plants.

Condition of Population in Study Area:

No information establishing this snail's occurrence at Crescent City Harbor is available. However, at Point St. George its existence is threatened by housing development and overgrazing.

IMPACTS OF THE ALTERNATIVES

The proposed project is not expected to cause secondary growth of population or industry within the vicinity of Crescent City Harbor. Therefore, any impacts to endangered and candidate species should be limited to those resulting directly from project construction and maintenance.

California Brown Pelican

The dredging and disposal operations will cause a temporary increase in turbidity in Crescent City Harbor and the offshore disposal site. However, the biological productivity of the area should not be seriously affected nor should the pelican's ability to forage be hampered. Therefore, the project is not expected to significantly impact brown pelicans which utilize the project area.

American Peregrine Falcon

The peregrine falcon is an occasional visitor to the project area and draws upon a plentiful food resource (i.e., passerines, shorebirds, and waterfowl) which would not be adversely affected by the project. Therefore, the project should not have a significant impact on the peregrine.

Aleutian Canada Goose

The geese utilize areas to the north of the project area and do not apparently utilize the harbor itself. As the project would have no impact on the habitats utilized by the birds, it is not expected to affect Aleutian Canada geese.

Endangered Whales

The gray whale may occasionally be found within 2 miles of shore. However, ocean disposal of dredge spoils at a site 1.3 miles offshore is not expected to impact this marine mammal if it is done outside of periods of gray whale migration which occur during the months of November-December and February-May.

Thurber's Reed Grass

Although Thurber's reed grass may be present in a wetland south of Crescent City, the plant has not been recorded within the immediate harbor vicinity. The project would not affect areas where Thurber's reed grass could potentially grow; i.e., freshwater wetlands. Therefore, it is not expected to impact this plant.

Rocky Coast Snail

The area at Point St. George where the snail is known to occur is located to the north of the project area and would not be affected by the project. The rocky coast snail is not known to exist at Crescent City Harbor. If the snail is found to inhabit the harbor area, the project, being limited to offshore construction, would not likely affect this species.

We appreciate the opportunity to assist you in identifying the potential impacts on endangered species resulting from construction of alternatives under consideration for navigation improvement in Crescent City Harbor.

Sincerely yours,

James J. McKevitt
Field Supervisor

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
300 South Ferry Street
Terminal Island, CA 90731

March 28, 1980 F/SWR33:TGY

James C. Wolfe, Acting Chief
Engineering Division
San Francisco District
Corps of Engineers
211 Main Street
San Francisco, CA 94105

Dear Mr. Wolfe:

Subject: Crescent City Harbor Navigation Project to deepen and widen the basin adjacent to the Petroleum Dock.

We have reviewed the subject project and have attended preliminary scoping meetings with your staff as well as representatives of other resource agencies. At present, it is difficult to provide guidance regarding potential impacts on fishery resources or marine mammals because the specific methodology for deepening the site has not been determined.

If the project could be completed without blasting, the concerns of the National Marine Fisheries Service (NMFS) would be minimized. If, however, the deepening requires six months of continuous blasting (as was suggested as a worst-case analysis), the NMFS would strongly favor relocation of the oil dock to an alternate site or a multipoint buoy and buried pipeline.

We are aware that there are navigational problems associated with these latter alternatives. Strong wave surges and winter storm conditions make the existing site more favorable for unloading barges than many other sites within the harbor. However, we believe that all alternatives, including moving the Petroleum Dock further north along the existing breakwall (and possibly extending the breakwall against wave action) should be evaluated if large-scale blasting is found to be necessary.

We look forward to the results of the coring and test-blasting programs to determine the hardness of the bottom material. When these evaluations have been completed, we may be better able to provide specific recommendations about potential impacts to fishery resources and marine mammals. The NMFS would appreciate participating in the pilot-blasting study this summer.

Please forward future correspondence on this project to Mr. Thomas Yocom, National Marine Fisheries Service, 3150 Paradise Drive, Tiburon, CA 94920; (FTS-8-556-0565).

Sincerely,

Floyd S. Anders, Jr.

Floyd S. Anders, Jr.
Acting Regional Director

United States Department of the Interior

FISH AND WILDLIFE SERVICE
LLOYD 500 BUILDING, SUITE 1692
500 N.E. MULTNOMAH STREET
PORTLAND, OREGON 97232

September 18, 1979

In reply refer to:
AFA-SE

Colonel John M. Adsit
District Engineer
San Francisco District
Corps of Engineers
211 Main Street
San Francisco, California 94105

Dear Colonel Adsit:

As requested by letter from James C. Wolfe, Acting Chief, Engineering Division, dated June 20, 1979, you will find attached a list of the proposed and listed endangered and threatened species (Attachment A) that may be present in the area of the proposed Crescent City Harbor Navigation Project, Del Norte County, California. The list is intended to fulfill the requirement of the Fish and Wildlife Service to provide a list of species under Section 7(c) of the Endangered Species Act, as amended. Please see Attachment B for your requirements.

Also for your assistance, we have included a list of species that are candidate species. These species are presently being reviewed by this Service for consideration to propose and list as endangered or threatened. It should be noted that the candidate species have no protection under the Endangered Species Act and are included for your consideration as it is possible the candidates could become formal proposals and be listed during the construction period.

Upon completion of the biological assessment (see Attachment B), should you determine that a listed species is likely to be affected (adversely or beneficially), then your agency should request formal Section 7 consultation through this office. If there are both listed and proposed species (or candidate species, if included in the assessment) that may be affected; then if requested, we will informally consult on the proposed (or candidate) species during the formal consultation. However, should the assessment reveal that only proposed species (or candidate species) may be affected, then you should consider informal consultation with our Area Office at the following address:

September 18, 1979
Page Two

William D. Sweeney
2800 Cottage Way, Room E-2740
Sacramento, California 95825
Phone: FTS 468-4664

One of the benefits of informal consultation to the consulting agency is to provide the necessary planning alternatives should a proposed (or candidate) species become listed before completion of a project.

Should you have any additional questions regarding your responsibilities under the Act, please contact the Area Manager listed above. We thank you for your interest in endangered species, and we await your assessment.

Sincerely yours,

R. Kahler Martinson

R. Kahler [illegible]
Regional Director

Attachments

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES, AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED CRESCENT CITY HARBOR NAVIGATION PROJECT

LISTED SPECIES

Aleutian Canada goose, *Branta canadensis leucopareia*

California brown pelican, *Pelecanus occidentalis*

American peregrine falcon, *Falco peregrinus anatum*

Gray whale, *Eschrichtius gibbosus*

PROPOSED SPECIES

Rocky coast snail, *Monadenia fidelis pronotis*

CANDIDATE SPECIES

Thurber's reed grass, *Calamagrostis crassiglumis*

FEDERAL AGENCIES' REQUIREMENTS UNDER SECTION 7(c)

Biological Assessments

This process is initiated by a Federal agency in requesting a list of proposed and listed endangered and threatened species that may be within the area of a construction project.[1] The purpose of the assessment is to identify any proposed and/or listed species which are/is likely to be affected by a construction project. The assessment should be completed within 180 days after initiation of the assessment (or within such a time period as is mutually agreed to by our two agencies). No irreversible commitment of resources is to be made during the biological assessment process which would result in violation of your requirement under section 7(a) of the Act. Planning, design, and administrative actions may be taken by your agency; however, no construction may begin.

Your agency should conduct an on-site inspection of the area to be affected by the proposal which may include a detail survey of the area to determine if the species is present and whether suitable habitat exists for either expanding the existing population or for potential reintroduction of the species. Review literature and scientific data to determine species distribution, habitat needs, and other biological requirements. Interview experts including those within Fish and Wildlife Service, National Marine Fisheries Service, State conservation departments, universities and others who may have data not yet published in scientific literature. Review and analyze the effects of the proposal on the species in terms of individuals and populations, including consideration of cumulative effects of the proposal on the species and its habitat. Analyze alternative actions that may provide conservation measures. At the conclusion of the assessment as described above, the Federal agency shall prepare a report documenting the results. The report shall also include a discussion of study methods used, any problems encountered, and other relevant information. The report should be forwarded to this office.

1/ "Construction Project" means any major Federal action which significantly affects the quality of the human environment designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like. This includes Federal actions such as permits, grants, licenses, or other forms of Federal authorization or approval which may result in construction.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
2800 Cottage Way, Rm. E-2727
Sacramento, California 95825

November 13, 1979

Colonel John M. Adsit
District Engineer
San Francisco District, Corps of Engineers
211 Main Street
San Francisco, California 94105

Subject: Crescent City Inner Harbor

Dear Colonel Adsit:

We are providing the following information on the referenced project pursuant to our meeting on October 30, 1979.

As we indicated at the meeting, the Service has not taken a position on the use of blasting techniques for the proposed navigation improvements. At this time, however, we are extremely concerned about the potential impacts blasting could have on fish and wildlife resources and, as such we will most likely request a thorough investigation of more preferable alternatives and their implementation where feasible. This could, for example, include measures to minimize blasting impacts such as use of a bubble screen to help disperse refractive waves, and employing alternative stone removal methods in conjunction with blasting to minimize the amount of detonation required. Our efforts will be coordinated closely with California Department of Fish and Game personnel and your staff. We will also explore the potential of testing these measures as you suggested and will take advantage of your offer to provide assistance.

In addition, because this project could affect endangered species, I would like to repeat my earlier request that, if your agency anticipates requesting a biological opinion, the consultation process be undertaken immediately. We cannot complete our Fish and Wildlife Coordination Act report until this opinion has been issued.

Thank you for the opportunity to voice our concerns and clarify the Service's present view of the project.

Sincerely,

James J. McKevitt

James J. McKevitt
Field Supervisor

APPENDIX D

CULTURAL RESOURCES APPENDIX

APPENDIX D

CULTURAL RESOURCES APPENDIX

1. Coordination and Background Research

In compliance with Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C. 470 (f)) and Executive Order 11593 of 13 May 1971 the most recent listing of the National Register of Historic Places (with monthly supplements up to 3 February 1981), and the State Historic Preservation Officer were consulted with the result that no properties listed in, or eligible to, the National Register of Historic Places were found to be within the impact area of the proposed project (see attached letter of 1 February 1980 from the State Department of Parks and Recreation).

In addition, a literature search was conducted by the Regional Office of the California Archaeological Site Survey, Sonoma State University, with the result that no archaeological and/or historic sites were found to be within the impact area of the proposed project (see attached letter of 9 February 1979 from Sonoma State University).

2. Impacts

Both the dredging and disposal areas are entirely submerged beneath harbor waters. It is therefore unlikely that any cultural resources are extant within the project area. Background research (supra) revealed no known cultural resources within the project area, and did not indicate any probability of their existence. The Corps has therefore determined that the proposed undertaking will have no effect upon archeological and/or historic resources. However, in the unlikely event that an archaeological and/or historic resource is discovered in the course of the undertaking, work shall cease pending notification of the State Historic Preservation Officer, and a professional evaluation of the discovered resource. The Corps would comply fully with the terms of 36 CFR 800.7 and the Archaeological and Historic Preservation Act of 1974.

Sonoma State University

ANTHROPOLOGICAL STUDIES CENTER
CULTURAL RESOURCES FACILITY
707 - 664-2381

9 February 1979

Nadine Mandel
Environmental Branch
San Fransisco District
Corps of Engineers
211 Main Street
San Fransisco, CA

Re: Archaeological record search for a proposed dredging project in Crescent City Harbor, Crescent City, California.

Dear Ms. Mandel:

This memo documents an archaeological record search conducted in response to your telephoned request of 7 February 1979 for a planned harbor dredging project in the Crescent City inner harbor. The archaeological base maps, site records, and archaeological survey reports on file at the Northwest Regional Center of the California Archaeological Sites Survey were consulted to determine if any previously recorded archaeological sites were situated within or near the project area.

One recorded archaeological site, CA-DNO-16, was situated in close proximity to the project area although not within the direct impact area of the project. Another recorded archaeological site, CA-DNO-38 was situtated within one mile of the project area. Copies of these site records and the records for four other archaeological sites in the Crescent City vicinity have been enclosed with this memo. In addition, a copy of an environmental impact report conducted near the subject area has been enclosed.

Since the planned project will not involve shoreline areas, we do not recommend an archaeological survey at this time. However, in the event that operation of heavy equipment or land modification is conducted along the shoreline of the Crescent City harbor, then a qualified archaeologist should be contacted to conduct an intensive archaeological survey of any areas to be modified.

We appreciate the opportunity to respond in this matter. If there are any questions concerning the findings of this record search, please feel free to contact the Cultural Resources Facility, Sonoma State University.

Sincerely,

Nelson B. Thompson

Nelson B. Thompson
Staff Archaeologist

Rohnert Park, California 94928

The California State University and Colleges

STATE OF CALIFORNIA—THE RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF PARKS AND RECREATION

P.O. BOX 2390

SACRAMENTO 95811

(916) 445-8006

FEB 1 1[illegible]

Colonel John M. Adsit
District Engineer
U.S. Army Corps of Engineers
211 Main Street
San Francisco, CA 94105

Dear Colonel Adsit:

Crescent City Harbor Navigation Project

I have received your letter of January 4, 1980 regarding the proposed deepening of the inner-harbor channel in Crescent City, Del Norte County.

On the basis of the information which you have provided, I can concur that no properties eligible for listing in the National Register of Historic Places are located within the project's area of potential environmental impact.

The requirements of the National Historic Preservation Act of 1966 have been met for this undertaking. If we can be of any further assistance, please do not hesitate to contact Jeffrey Bingham at (916) 322-8701.

Sincerely yours,

Knox M Mellon

Dr. Knox Mellon
State Historic Preservation Officer
Office of Historic Preservation

C-0635D

EA Report ACE91A2

APPENDIX E
PART 1

DATA REPORT ON THE OCEAN DISPOSAL SITE SURVEYS AT CRESCENT CITY HARBOR, DEL NORTE COUNTY, CALIFORNIA

Prepared for

Department of the Army
San Francisco District
Corps of Engineers
211 Main Street
San Francisco, California 94105

Prepared by

Ecological Analysts, Inc.
2150 John Glenn Drive
Concord, California 94520

April 1980

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1. INTRODUCTION

1.1 BACKGROUND

This study was conducted in partial fulfillment of Section 103 of Public Law 92-532 (Marine Protection, Research and Sanctuaries Act of 1972) which requires evaluation of the ocean disposal of dredged material to determine the potential for impact of such disposal on the marine environment. Regulations describing the criteria to be applied pursuant to P.L. 92-532 were published by the Environmental Protection Agency (EPA) in the 11 January 1977 Federal Register (Vol. 42, No. 7 and later appeared in the Code of Federal Regulations [Title 40, parts 220-229; hereafter referred to as 40 CFR]).

The Crescent City Harbor Project, Del Norte County, California, was authorized for construction in 1965. It is proposed to place the dredged material from the Harbor at the interim designated ocean disposal site (40 CFR 228.12). This data report provides input to the Army Corps of Engineers (COE) for a final site designation.

Using guidelines in 40 CFR 228.13, San Francisco District COE developed a study plan outlining the type and number of samples to be collected during two field surveys of the proposed ocean disposal site near Crescent City Harbor, California.

On 29 May 1979 the COE awarded a contract to Ecological Analysts, Inc. (EA) to conduct the two field surveys (Contract No. DACW07-79-C-0048).

1.2 PURPOSE

Two complete field surveys, a summer study and a fall study, were conducted in 1979. The summer survey was carried out between 25 June and 20 July; the fall survey between 1 and 11 November.

The surveys were designed to: (1) identify the resident marine biota; (2) describe the physical parameters (currents, thermoclines, water quality profiles) in and around the proposed disposal site; and (3) identify any background levels of chemical contaminants in the seawater and sediments in and around the proposed disposal site and at six potential reference sites.

1.3 STUDY LOCATION

The two field surveys were conducted at proposed disposal and reference site locations in and near Crescent City Harbor, about 27 km south of the California-Oregon border. The proposed disposal site is an EPA interim designated site located at 124° 12' 00" west longitude and 41° 43' 15" north latitude. The disposal site is approximately 1.5 nautical miles from Crescent City Harbor on a heading of 186°; 2,100 m from the tip of the east jetty (Figure 1). The disposal site is 914 m in diameter and is located in approximately 27 m of water.

Six reference sites (Figure 2) located near Crescent City Harbor, in water depths ranging from 2 to 10 m, were sampled during both summer and fall surveys.

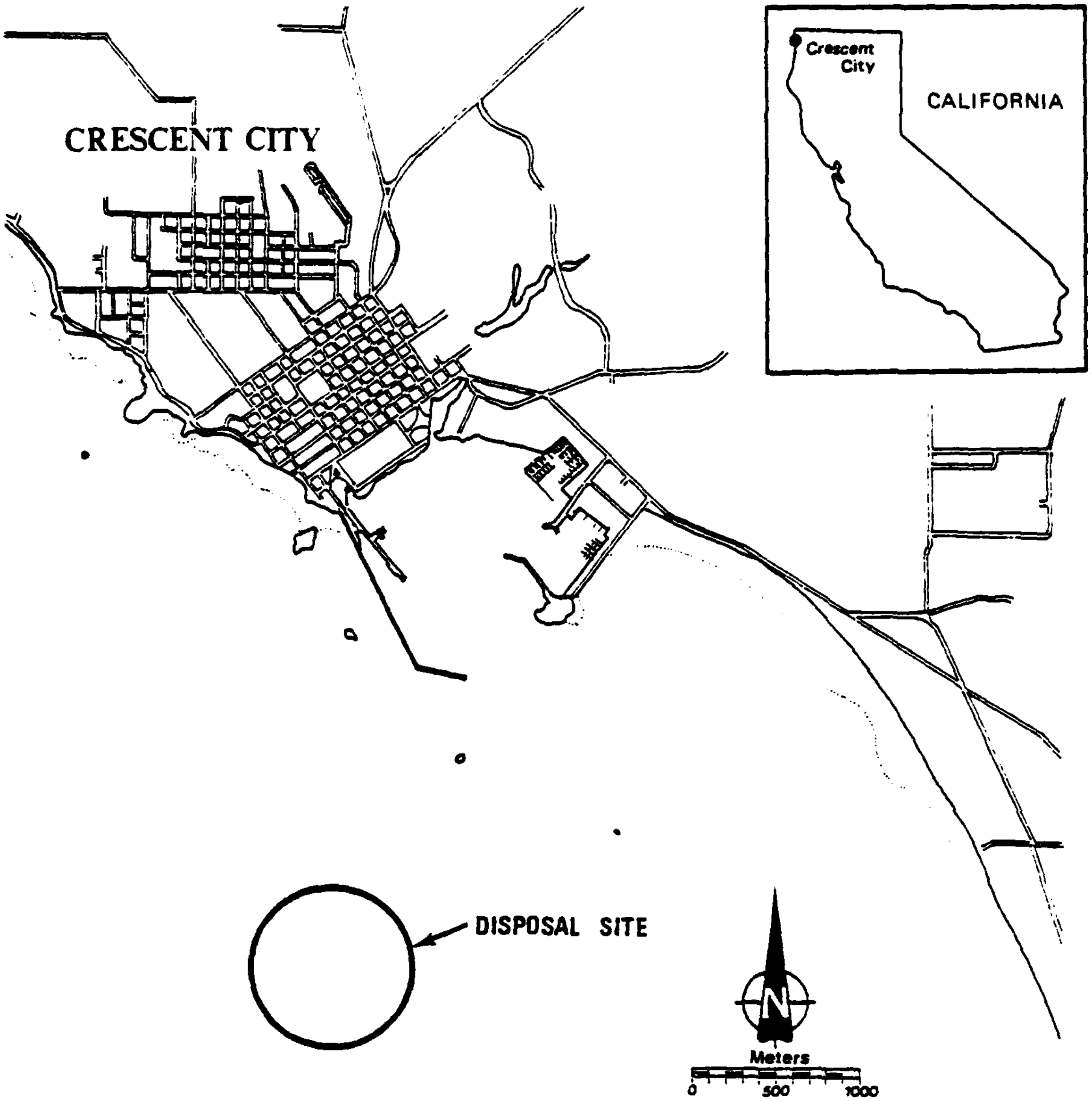

Figure 1. Proposed disposal site location near Crescent City Harbor, California.

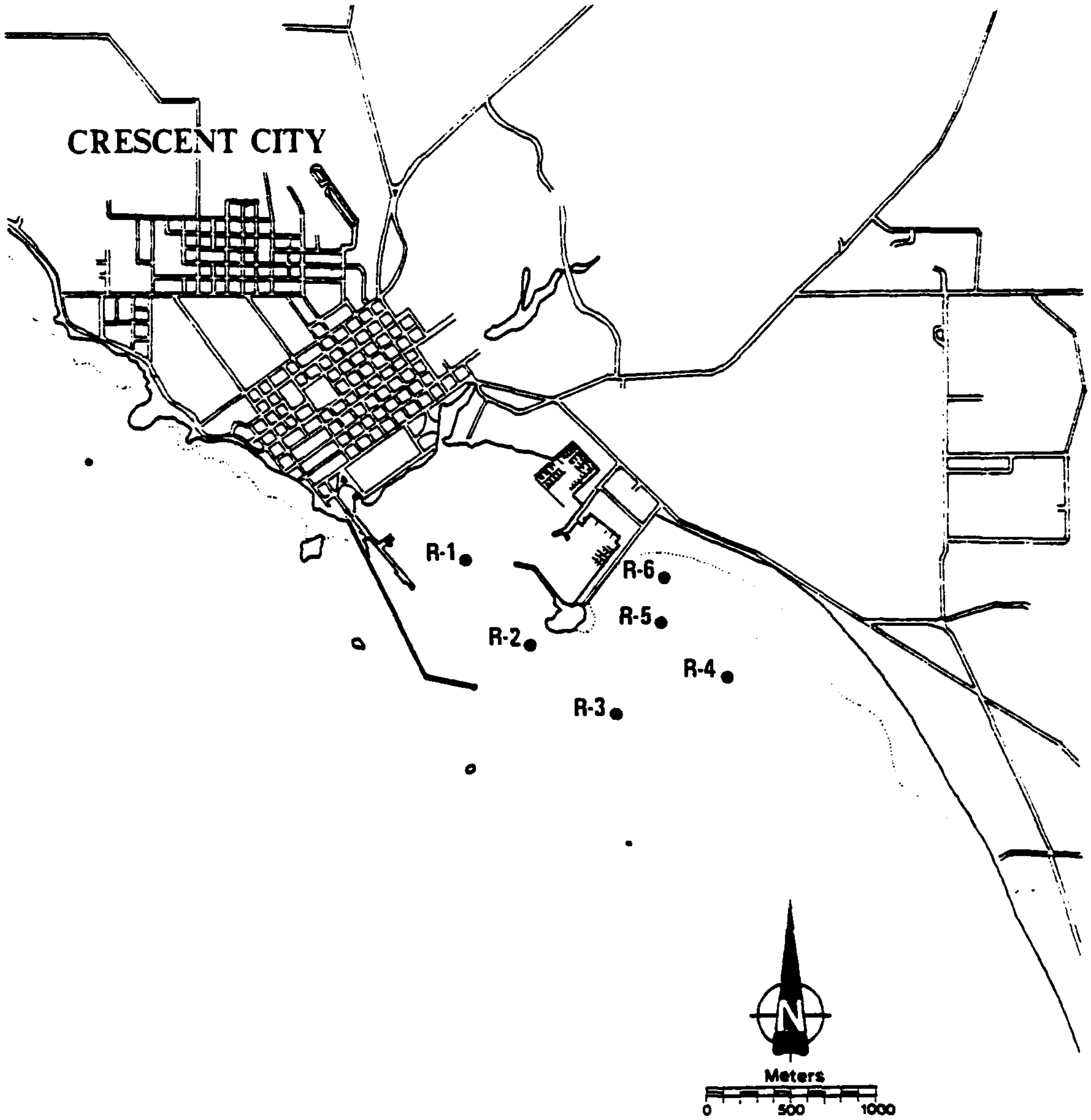

Figure 2. Station locations of six potential reference sites near Crescent City Harbor, California, June and November 1979.

2. METHODS AND MATERIALS

The field surveys were designed to characterize the physical, chemical, and biological conditions existing at proposed dredged material disposal and reference site locations. During the surveys, general observations of sea conditions, surface phenomena, and commercial or sport fishing activities were noted. Except where specifically mentioned, the following methods were employed during both summer and fall surveys.

2.1 PHYSICAL SURVEYS

Temperature and conductivity measurements were made at the center of the proposed disposal site (Station F, Figure 3) at 2-m depth intervals in the summer and 3-m depth intervals in the fall using a Martek Instruments MARK V water quality monitoring system. At Stations 1 through 7 (Figures 4 and 5) measurements of temperature, conductivity, dissolved oxygen, pH, and turbidity were taken at 3-m depth intervals for both surveys using the Martek system and a Turner Design nephelometer.

In the summer survey, current speed and direction were measured at Stations A-F (Figure 3) at the surface, the bottom, middepth, and the thermocline, using a Marsh-McBirney Model 527 electromagnetic current meter. A single release of Rhodamine B dye was made at the disposal site center and followed for 15 minutes.

In the fall survey, current was measured only at the surface, the bottom, and middepth, because there was no evidence of a distinct thermocline. The Rhodamine B dye patch was tracked for 3 hours in the fall survey. In each survey, the prevailing bottom current direction was used to set the station locations for chemical and biological studies.

A single bottom grab sample was taken at each of seven disposal site stations (Figures 4 and 5) and six potential reference site stations (Figure 2) using an 0.1-m^2 Smith-McIntyre grab sampler. The samples from each station were split into two fractions. One fraction was preserved on ice for particle size analysis, and the other was preserved on ice for chemical analysis. The sediment samples collected for particle size analysis were each split, dried at 105 C, and analyzed using standard sieve sizes of 2,000, 850, 500, 150, and 75 µm and pan (<75 µm). Shaking time was 5 minutes, plus or minus 5 seconds.

2.2 CHEMICAL SURVEYS

Water samples for chemical analysis were collected 1 m below the surface and 1 m above the bottom at each of seven stations (Figures 4 and 5) using Beta Plus and Nansen water sampling bottles.

The collection of sediment samples for preparation and chemical analyis has been described in Section 2.1. The elutriate used in the chemical analysis of the sediment was prepared in accordance with 40 CFR 227.32.

The chemical analyses of seawater and sediment samples taken during the summer survey were carried out by Ultrachem Corporation, Walnut Creek, California.

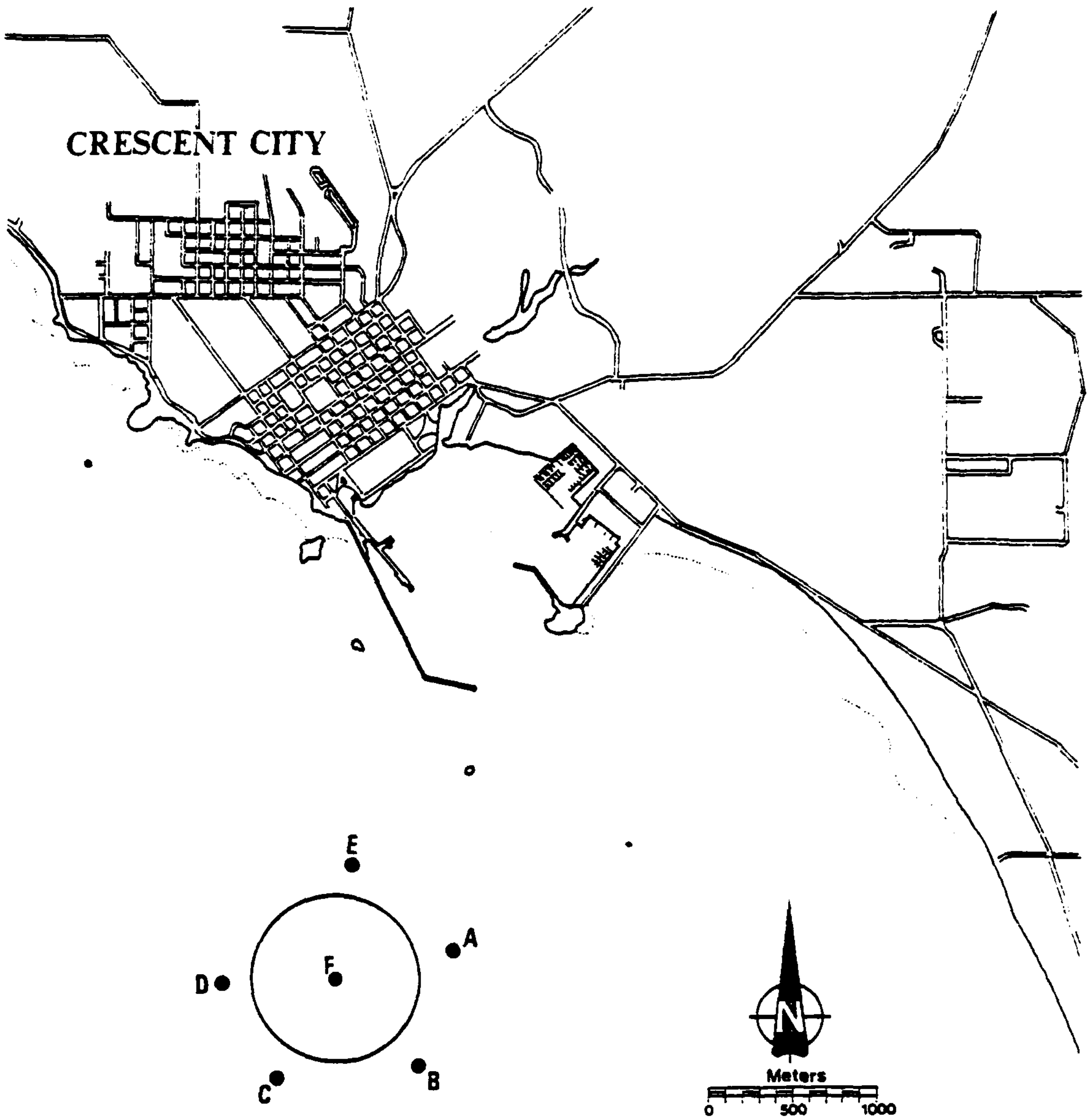

Figure 3. Station locations for current speed and direction samples near Crescent City Harbor, June and November 1979.

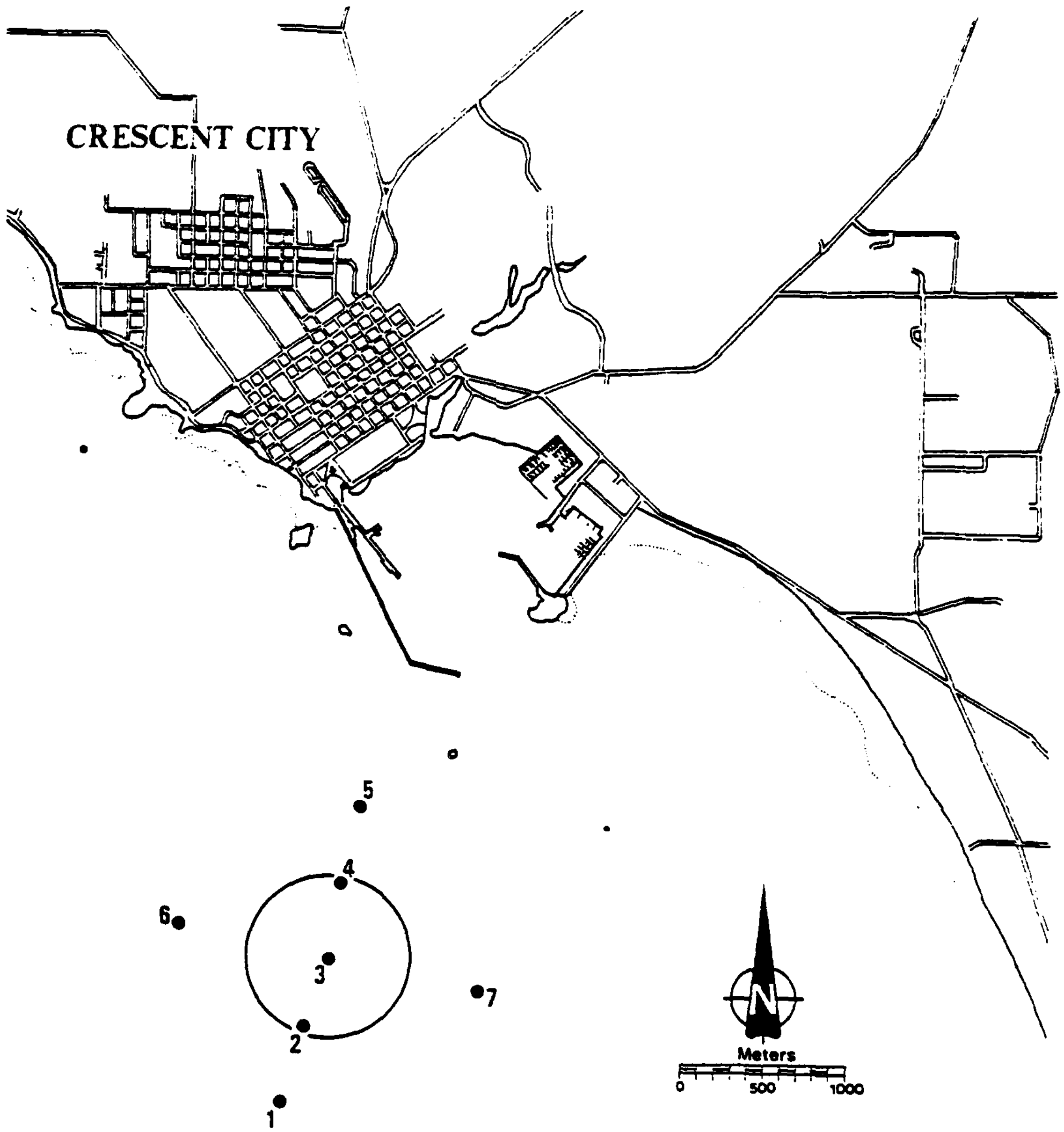

Figure 4. Station locations for phytoplankton, benthic, sediment, and water quality studies near Crescent City Harbor, California, June 1979.

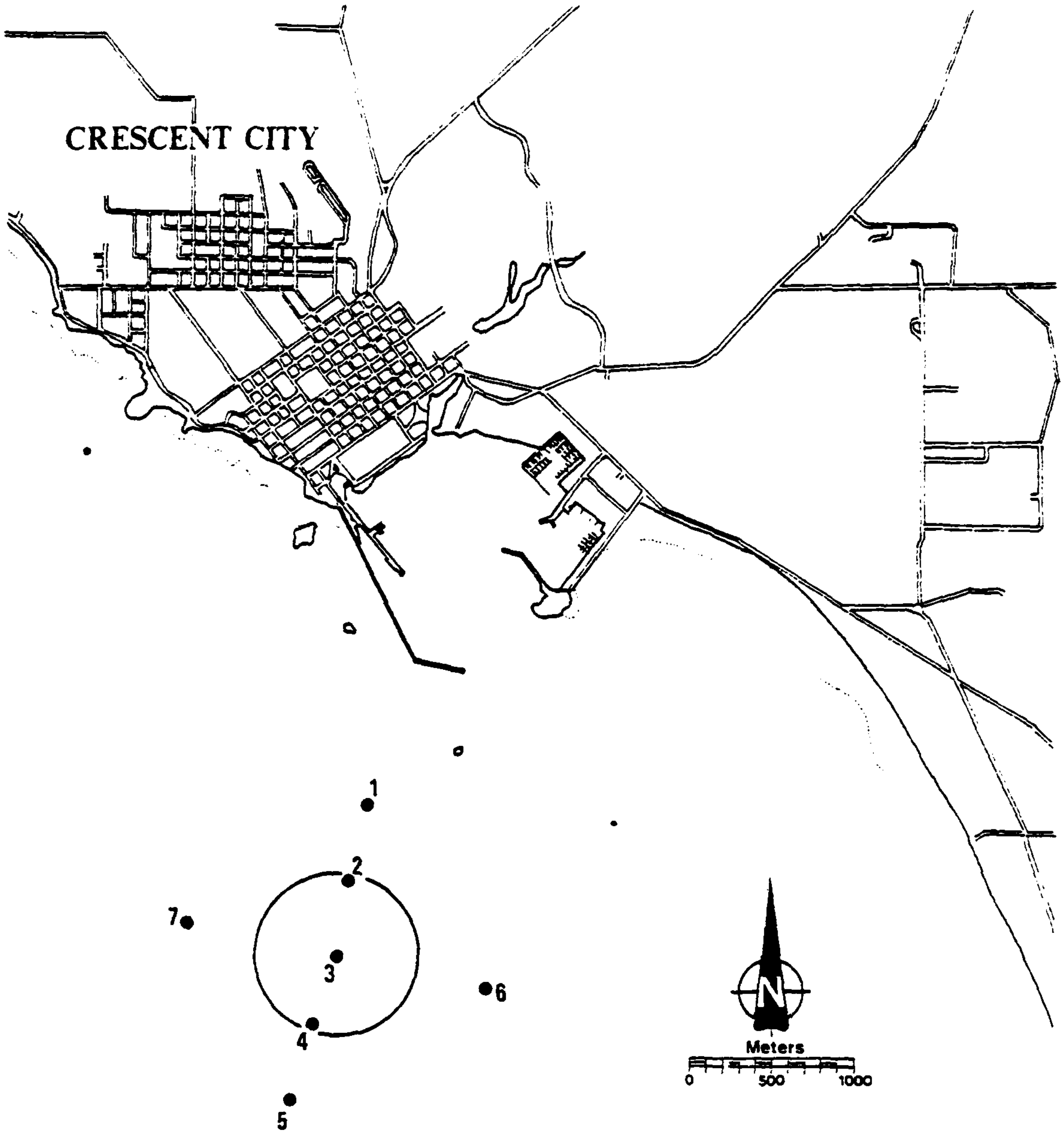

Figure 5. Station locations for phytoplankton, benthic, sediment, and water quality studies near Crescent City Harbor, California, November 1979.

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Cadmium, lead, copper, and zinc were analyzed by direct flame atomic absorption spectrophotometry on samples preserved in nitric acid. Mercury was determined by cold vapor atomic absorption following acid-permanganate digestion. Phenols were determined colorimetrically by the chloroform extraction method after distillation. Petroleum hydrocarbons were determined gravimetrically by freon extraction. Chlorinated hydrocarbons were extracted from the samples with dichloromethane/hexane, concentrated, and analyzed by gas chromatography using an electron capture detector.

The chemical analyses of seawater and sediment samples collected during the fall survey were carried out by Brown and Caldwell (BC), Emeryville, California. The methods used by BC for the analysis of mercury, zinc, phenols, oil and grease, and chlorinated hydrocarbons were similar to those used by Ultrachem Corporation, but the samples analyzed by BC for cadmium, copper, and lead were first concentrated by chelation and extraction before being analyzed by direct flame atomic absorption spectrophotometry. The detection limits for the two sets of analyses are shown in Table 1.

2.3 BIOLOGICAL SURVEYS

Phytoplankton samples for total chlorophyll analysis were collected at Stations 1, 3, 5, 6, and 7 (Figures 4 and 5) by pumping 1 liter of filtered (333-µm mesh) sea water from approximately 1 m below the surface into glass containers which were in turn stored in the dark on ice. On shore, the samples were filtered through 0.45-µm Millipore filters and stored on ice. Chlorophyll determinations were made by Anatec Laboratories, Dillon Beach, California. Total chlorophyll was determined by measuring the optical density of an acetone plankton concentrate with a spectrophotometer.

Zooplankton were sampled day and night along six transects (Figure 6) using paired 0.5-m nets (333-µm mesh) mounted on rigid metal frames. After each oblique tow, the nets were washed down with filtered sea water and samples were preserved in a 5 percent buffered formalin solution.

Five benthic samples were taken at each of the seven stations (Figures 4 and 5) with a 0.1-m^2 Smith-McIntyre grab sampler. Organisms from each grab sample were separated from the sediment in the field by sieving through a 1-mm mesh screen. All retained organisms were preserved with a 10 percent buffered formalin solution.

Fish and epibenthic macroinvertebrates were sampled along four transects (Figure 7) day and night, using a 7.31-m otter trawl fitted with 6-mm mesh at the codend. Tows were 5 minutes long and were conducted in both directions along each transect, for a total of 16 tows per survey. Fish from the otter trawls were identified and enumerated onboard.

Zooplankton and benthic and epibenthic macroinvertebrates were identified and enumerated in Ecological Analysts' taxonomic laboratory in Concord, California.

TABLE 1 CHEMICAL DETECTION LIMITS OF ANALYSES CARRIED OUT BY ULTRACHEM CORPORATION AND BROWN AND CALDWELL

	Detection Limits (ppm)	
	Ultrachem Corporation	Brown and Caldwell
Cadmium	0.1	0.001
Lead	0.3	0.001
Zinc	0.1	0.01
Copper	0.08	0.001
Mercury	0.002	0.0001
Phenol	0.004	0.001
Oil & Grease (Freon extractable)	1.0	5.0
Chlorinated hydrocarbons	0.0001	0.0001
Polychlorinated biphenyls	0.0005	0.0001

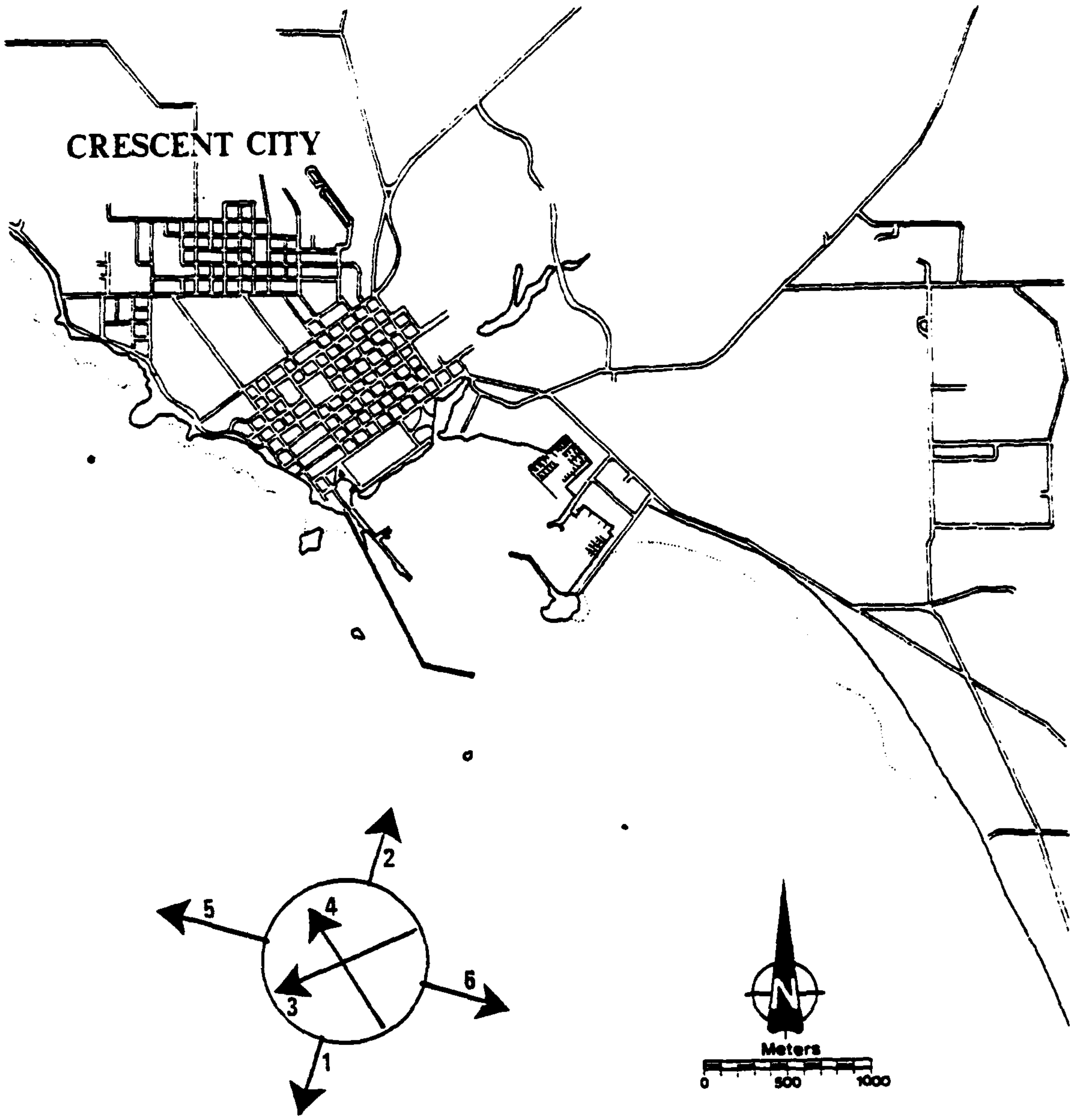


Figure 6. Transect locations for zooplankton tows near Crescent City Harbor, California, June and November 1979.

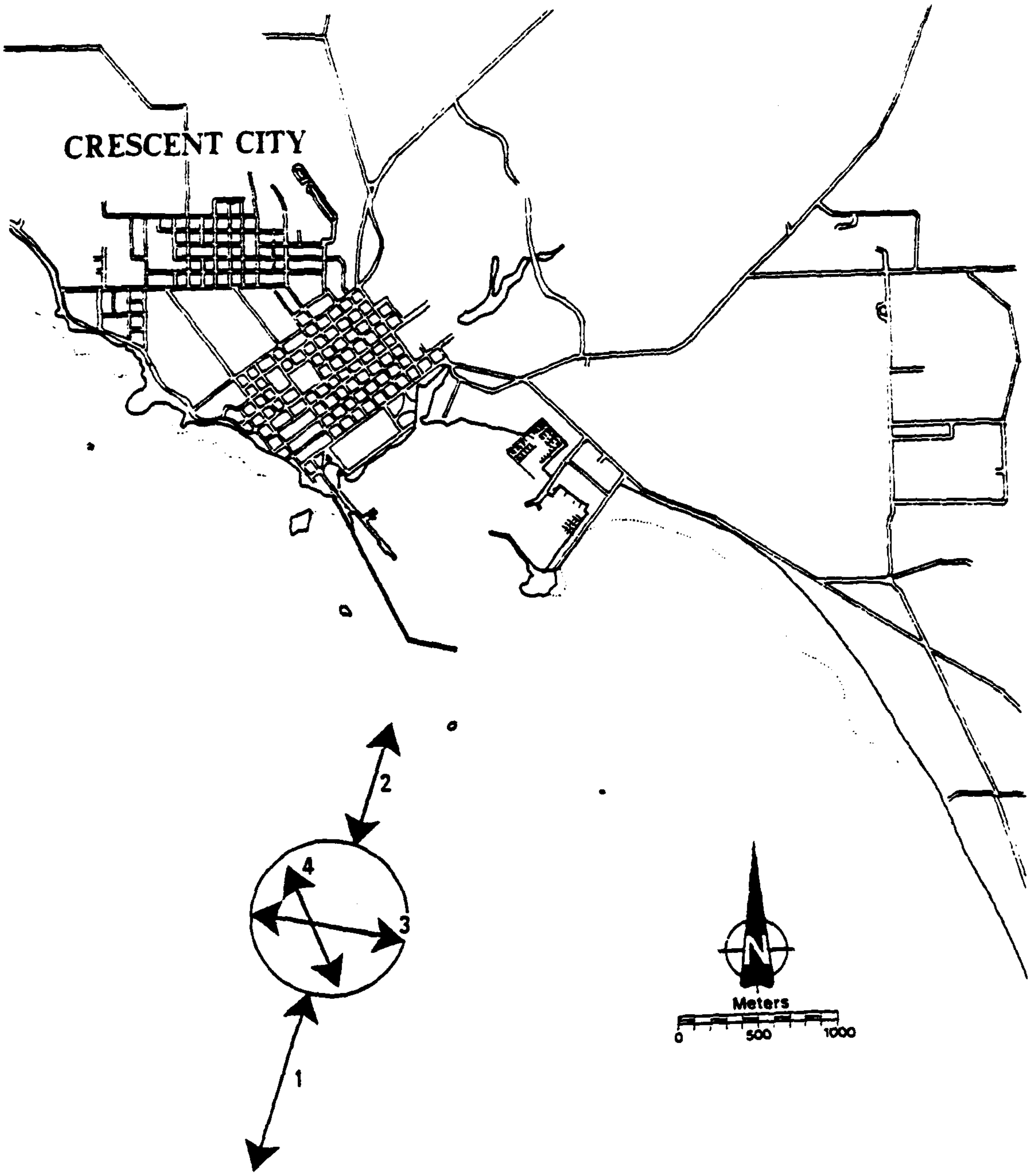


Figure 7. Transect locations for otter trawl tows near Crescent City Harbor, California, June and November 1979.

3. RESULTS AND DISCUSSION

Physical and biological conditions at the proposed disposal site varied considerably between the summer and fall surveys. A highly stratified water column in the summer survey was replaced by a well-mixed water column in the fall survey. The direction of the bottom current turned 180°, from a northerly direction in the summer to a southerly direction in the fall. The abundance of phytoplankton and zooplankton was lower in the fall survey than in the summer survey. Chemical and sedimentological characteristics did not change appreciably between surveys at the proposed disposal and reference sites.

3.1 PHYSICAL SURVEYS

Sea conditions at the proposed disposal site were highly variable during the two surveys. In the summer, wave heights ranged from 0 to 3 m; in the fall, from 0 to 5 m. Sampling activities were interrupted for two days in the fall survey by heavy seas.

During both surveys the surface of the sea remained relatively free of floating material, oil slicks, or other visible signs of pollution. Although no commercial fishermen were observed at the disposal site, EA collected two commercial crab pots during summer epibenthic trawling. Sport fishermen were observed near the disposal site during both surveys.

The water column at the center of the disposal site was highly stratified in June 1979. A sharp thermocline was found between 8 and 12 m and a less distinct halocline between 6 and 10 m (Table 2). The water column was considerably less stratified in November, and there was no evidence of a thermocline (Table 3).

The depth profiles at Stations 1-7 for temperature, conductivity, dissolved oxygen, and pH were all influenced by the stratification in the summer survey (Table 4). Surface temperatures averaged 12.3 C and bottom temperatures averaged 7.8 C. Conductivity increased with increasing depth at all stations, but there was little change in conductivity below the thermocline. Average dissolved oxygen levels were 10.0 ppm at the surface, increased to a maximum near the thermocline (10.4), and then dropped to low levels toward the bottom (2.6). The pH levels averaged 8.3 above the thermocline and decreased to an average of 7.4 near the bottom. Turbidity was at a minimum between 13 and 19 m (0.7 NTU) and appeared to be unaffected by the summer stratification.

The lack of stratification in the fall survey resulted in a nearly homogeneous water column at all stations (Table 5). The average water temperature was 13.5 C and the maximum difference between surface and bottom readings was 1.2 C. Dissolved oxygen levels averaged 9.5 ppm and were uniformly high throughout the water column. The pH averaged 7.9 and was nearly invariant across all stations and depths. Turbidity levels remained fairly constant, averaging 0.6 NTU. Conductivity was the only water quality parameter that appeared to be somewhat stratified in the fall survey. Surface values averaged about 46,000 µmhos; bottom values averaged approximately 50,000 µmhos.

TABLE 2 TEMPERATURES AND CONDUCTIVITIES AT THE CENTER OF THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Depth (m)	Temperature (C)	Conductivity (μmho)
Surface	12.0	43,750
2	11.9	44,400
4	11.8	44,580
6	11.8	44,870
8	11.2	45,850
10	9.8	46,100
12	8.1	46,640
14	7.9	46,670
16	7.8	46,700
18	7.8	46,650
20	7.8	46,690
22	7.8	46,700
24	7.8	46,700
26	7.8	46,690

TABLE 3 TEMPERATURES AND CONDUCTIVITIES AT THE CENTER OF THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Depth (m)	Temperature (C)	Conductivity (µmho)
1	12.6	48,020
4	12.8	48,760
7	12.4	48,830
10	12.5	48,950
13	12.5	49,100
16	12.5	49,260
19	12.2	49,770
22	12.1	49,940
25	11.9	49,900
28	11.5	49,840
30	11.5	49,790
31	12.1	49,970

TABLE 4 WATER QUALITY PARAMETERS AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Depth (m)	Station 1	2	3	4	5	6	7
				Temperature (C)			
1	12.2	12.5	12.2	12.2	12.5	11.8	12.5
4	11.6	11.8	12.1	11.9	11.9	11.4	11.9
7	10.9	11.0	10.9	11.6	11.5	10.9	11.5
10	10.5	10.9	8.6	10.7	9.9	9.7	11.3
13	8.4	8.8	8.0	9.3	9.2	8.3	10.7
16	8.0	8.3	8.0	8.7	8.4	7.9	9.6
19	7.8	7.9	8.0	8.5	8.3	7.9	8.7
22	7.7	7.9	8.0	8.3	8.1	7.8	8.4
25	7.6	7.7	7.7	8.1	7.9	7.7	
28	7.5	7.6	7.6	8.0	7.9	7.6	
31	7.5	7.5				7.5	
				Conductivity (μmho)			
1	44,580	43,400	44,820	45,500	43,700	44,600	45,500
4	46,070	45,920	45,380	45,950	45,510	45,000	46,460
7	45,950	45,950	45,940	46,390	45,910	45,500	46,850
10	45,940	46,150	46,540	46,450	46,010	46,300	46,910
13	46,300	46,440	46,600	46,480	46,100	46,500	46,850
16	46,410	46,570	46,600	46,670	46,270	46,750	46,810
19	46,370	46,540	46,720	46,780	46,350	46,740	46,950
22	46,410	46,580	46,870	46,850	46,350	46,710	46,950
25	46,440	46,630	46,910	46,890	46,460	46,730	
28	46,480	46,630	46,840	46,950	46,420	46,810	
31	46,530	46,600				46,820	
				Dissolved Oxygen (mg/l)			
1	10.1	9.9	9.6	10.4	9.8	10.1	10.4
4	10.5	10.3	10.0	10.6	10.6	10.2	10.5
7	10.8	10.2	10.1	10.6	10.5	10.1	10.5
10	11.2	10.9	8.0	10.0	9.6	9.9	10.1
13	8.3	8.8	4.5	8.4	9.1	8.7	9.4
16	6.1	8.8	3.9	7.3	6.8	2.7	9.0
19	2.6	3.0	3.2	6.7	6.6	2.4	6.8
22	2.5	2.4	3.0	5.6	5.5	2.3	5.5
25	2.1	2.2	0.9	4.6	3.4	1.2	
28	2.0	2.0	0.6	4.2	3.3	1.6	
31	1.6	1.9				1.3	

Note: -- indicates voided sample.

TABLE 4 (CONT.)

Depth (m)	Station 1	2	3	4	5	6	7
				pH			
1	8.2	8.3	8.3	8.3	8.5	8.3	8.3
4	8.2	8.2	8.3	8.3	8.4	8.2	8.3
7	8.2	8.2	8.2	8.3	8.3	8.2	8.2
10	8.2	8.2	7.9	8.2	8.1	8.1	8.2
13	7.9	7.9	7.6	7.9	8.0	7.9	8.1
16	7.2	7.9	7.5	7.8	7.8	7.5	8.0
19	7.4	7.4	7.4	7.7	7.7	7.4	7.8
22	7.4	7.4	7.4	7.6	7.6	7.4	7.7
25	7.4	7.4	7.3	7.6	7.4	7.3	
28	7.4	7.4	7.3	7.5	7.4	7.4	
31	7.4	7.4					
				Turbidity (NTU)			
1	1.2	1.0	0.5	1.1	0.7	2.0	0.9
4	0.7	0.9	0.6	0.7	0.3	0.5	0.7
7	0.7	1.0	0.6	0.6	0.4	0.5	1.0
10	0.5	0.7	0.9	0.4	0.3	0.5	0.8
13	0.6	0.9	0.5	0.8	0.5	0.5	0.9
16	0.6	0.7	1.0	0.9	0.6	0.7	0.8
19	0.6	0.8	1.0	1.3	0.6	0.7	0.8
22	0.8	1.1	1.1	1.6	1.7	2.4	0.9
25	1.1	1.5	1.6	4.6	1.2	1.8	
28	1.5	1.7	2.3	1.5	0.9	2.0	
31	1.1	--				2.5	

TABLE 5 WATER QUALITY PARAMETERS AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Depth (m)	Station 1	2	3	4	5	6	7
				Temperature (C)			
1	14.0	13.4	13.5	13.5	13.5	13.4	13.4
4	13.5	13.8	13.5	13.5	13.5	13.5	13.3
7	12.9	13.7	13.5	13.5	13.5	13.6	13.0
10	13.3	13.3	13.6	13.6	13.5	13.7	13.1
13	13.0	13.5	13.6	13.6	13.6	13.6	13.3
16	12.8	13.7	13.6	13.6	13.6	13.6	13.3
19	12.7	13.6	13.6	13.6	13.6	13.6	13.3
22	12.7	13.4	13.5	13.6	13.6	13.6	13.2
25	12.9	13.3	13.5	13.6	13.5	13.6	13.3
28	13.1	13.7		13.6	13.5	13.6	13.4
31	12.8	13.5					13.1
				Conductivity (μmho)			
1	47,640	47,800	46,400	46,680	46,840	45,200	45,650
4	48,150	47,800	47,000	47,030	46,950	47,160	46,750
7	48,350	48,350	47,660	47,900	47,000	48,480	47,000
10	48,570	48,730	48,800	48,450	47,000	49,350	47,120
13	49,000	49,300	49,950	49,000	48,600	49,990	47,440
16	49,530	49,710	50,210	49,140	49,590	50,150	48,500
19	49,510	49,800	50,360	49,570	49,900	50,370	48,680
22	49,560	49,930	50,350	50,150	50,200	50,590	48,600
25	48,500	49,900	50,460	50,220	50,360	50,740	48,740
28	48,450	48,350		50,480	50,600	50,850	48,700
31	48,370	48,000					48,890
				Dissolved Oxygen (mg/l)			
1	10.1	10.1	9.2	8.2	8.4	10.0	10.2
4	10.0	10.1	8.9	8.2	8.3	9.8	9.9
7	10.0	10.0	9.2	8.4	8.2	9.9	9.9
10	10.0	10.1	9.0	8.2	8.1	9.9	9.9
13	10.0	10.0	9.0	8.1	8.0	9.9	9.9
16	10.0	10.0	9.0	8.1	7.9	9.8	9.9
19	10.0	10.0	8.9	7.9	8.0	9.6	9.9
22	9.7	10.0	8.9	7.9	8.3	9.5	9.7
25	9.8	9.9	8.9	7.8	7.9	9.4	9.5
28	9.8	9.8		7.1	7.4	9.2	9.3
31	9.6	9.5					9.2

TABLE 5 (CONT.)

Depth (m)	Station 1	2	3	4	5	6	7
				pH			
1	7.8	7.8	8.0	8.0	8.0	8.0	7.8
4	7.8	7.8	8.0	8.0	8.0	8.0	7.8
7	7.8	7.8	8.0	8.0	8.0	8.0	7.8
10	7.8	7.8	8.0	8.0	8.0	8.0	7.8
13	7.8	7.8	8.0	8.0	8.0	8.0	7.8
16	7.8	7.8	8.0	8.0	8.0	8.0	7.8
19	7.8	7.8	8.0	8.0	8.0	8.0	7.8
22	7.8	7.8	8.0	8.0	8.0	8.0	7.8
25	7.8	7.8	8.0	8.0	8.0	8.0	7.8
28	7.8	7.8		8.0	8.0	8.0	7.8
31	7.7	7.8					7.7
				Turbidity (NTU)			
1		0.5	0.5	0.6	0.4	0.7	0.8
4	0.5	0.5	0.5	0.6	0.6	0.8	0.8
7	0.9	0.5	0.4	0.5	0.7	0.4	0.6
10	0.5	0.4	0.6	0.4	0.9	0.6	0.6
13	0.5	0.3	0.5	0.4	0.5	0.6	0.8
16	0.5	0.3	0.5	0.4	0.4	0.3	0.6
19	0.4	0.4	0.5	0.7	0.8	0.6	0.7
22	0.4	0.5	0.5	0.7	0.5	0.4	0.5
25	0.5	0.4	0.5	0.5	6.0	0.5	0.6
28	0.4	0.4		5.0		0.6	0.5
31	0.5	0.5					0.9

During the summer survey, surface current speeds averaged 23.9 cm/sec with a range of 26.4 cm/sec; bottom current speeds averaged only 3.7 cm/sec with a range of 5.8 cm/sec (Table 6). In the fall survey, surface current speeds were lower, averaging 15.3 cm/sec, while bottom currents were greater, averaging 7.6 cm/sec, than the corresponding values in the summer survey (Table 7).

The direction of the surface current as measured by the current meter and dye studies was in a northerly direction during both surveys, 328° (magnetic) in summer and 302° in the fall. The bottom current direction, however, turned 180° between the summer survey (21°) and the fall survey (201°). These measurements were each taken on a single day and thus are not necessarily indicative of seasonal trends. In addition, our ability to track the dye patch visually was hampered by poor daylight and weather conditions. We would recommend substituting current drogue studies for the dye studies. Current drogues released at the center of the disposal site could be followed more easily and for longer periods than was possible with the dye.

Most of the sediment samples collected in both surveys at disposal and reference site stations were composed of medium- and fine-grained sands with particle sizes between 500 and 75 μm (Tables 8 and 9). The sediment from Station 7 in the summer survey was primarily a mixture of shell fragments and silt, and 56 percent of the sample had a particle size greater than 850 μm. The only unusual observation in the fall survey was at Station 1, where over 90 percent of the sediment was less than 75 μm in diameter. It was noted during benthic collections at the disposal site that the sediment characteristics often varied considerably at the same station: one grab would pick up rock, the next, silt. EA would recommend taking a composite sample of three or more grabs at each station to obtain a more representative estimate of the particle size distribution.

3.2 CHEMICAL SURVEYS

In the summer survey, all chemical contaminants analyzed in seawater samples were below the detection levels of standard analytical techniques, except at the surface at Stations 3 and 6, where mercury levels were measured at 3 and 5 ppb, respectively (Table 10). The analyses of sediment samples at the disposal site and reference site stations revealed no detectable levels of chemical contaminants, except for phenolic compound concentrations of 5 ppb at Stations 5 and 6 (Table 11). EPA has concluded that there are insufficient data to estimate a phenols criterion to protect saltwater aquatic life, but the proposed freshwater criterion of 3,400 ppb at any time (44 FR 43688, 25 July 1979) implies that the 5 ppb found at Crescent City is well below critical levels.

In the fall survey, cadmium, oil and grease, chlorinated hydrocarbons, and polychlorinated biphenyl contaminants were below detection levels in all seawater and sediment samples (Tables 12 and 13). Lead and copper levels were slightly higher in water samples than in sediment samples. Zinc and phenols were slightly higher in sediment samples than in water samples. Although there were no detectable levels of mercury in the water samples collected during the fall survey, mercury levels in the sediment samples averaged around 0.1 ppb, less than either the proposed 24-hour average concentration criterion of 0.19 ppb or the proposed not-to-to-exceeded criterion of 1.0 ppb

TABLE 6 CURRENT SPEEDS AND DIRECTIONS AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Station	Depth (m)	Current Speed (cm/sec)	Current Direction (° magnetic)
A	1	13.6	346
	10	8.9	281
	13	6.4	261
	26	3.6	73
B	1	21.2	8
	10	7.8	329
	13	5.1	303
	26	4.4	67
C	1	40.0	333
	10	7.2	273
	17	5.1	311
	34	1.4	360
D	1	17.1	330
	10	7.3	299
	18	9.2	277
	36	3.6	271
E	1	28.4	325
	10	7.8	290
	16	9.8	266
	32	2.0	80
F	1	22.8	271
	10	9.2	4
	14	4.5	266
	28	7.2	355

TABLE 7 CURRENT SPEEDS AND DIRECTIONS AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Station	Depth (m)	Current: Speed (cm/sec)	Current: Direction (° magnetic)
A	1	11.3	310
	10.5	18.5	81
	20	10.3	153
B	1	12.0	300
	15	11.8	101
	29.5	3.2	247
C	1	17.4	281
	19	6.8	214
	38.1	13.0	203
D	1	16.3	314
	16	3.1	191
	32.5	4.4	229
E	1	19.0	302
	14.5	9.4	137
	28.0	9.0	159
F	1	15.6	310
	15.5	9.6	12
	32.5	6.1	217

TABLE 8 PERCENTAGE (BY WEIGHT) RETAINED ON VARIOUS SIEVES OF SEDIMENTS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Sediment Classification	U.S. Standard Sieve Size[a]	Station												
		Disposal Site							Reference Site					
		1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Gravel	10 (2,000)	0.3	0.2	0.5	1.8	0.1	0.1	42.0	2.6	1.0	3.0	1.3	0.9	1.5
Coarse sand	20 (850)	1.0	0.6	1.4	0.6	0.7	0.7	13.9	2.2	1.3	1.3	1.2	1.9	2.3
Coarse sand	30 (500)	1.5	0.3	0.8	0.4	0.4	0.3	3.8	3.3	0.9	0.8	0.7	0.6	0.9
Medium sand	100 (150)	14.5	11.4	28.6	21.3	21.0	24.3	4.7	39.6	56.6	39	24.1	42.4	78.2
Fine sand	200 (75)	79.1	82.6	67.2	72.4	70.2	68.7	13.7	30.7	39.4	55.3	70.2	53.4	17.0
Silt	Pan (<75)	3.6	4.9	1.5	3.5	7.3	5.9	21.9	21.6	0.9	0.6	2.5	0.9	0.1

(a) Opening size (μm) is given in parentheses.

TABLE 9 PERCENTAGE (BY WEIGHT) RETAINED ON VARIOUS SIEVES OF SEDIMENTS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Sediment Classification	U.S. Standard Sieve Size[(a)]	Station												
		Disposal Site							Reference Site					
		1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Gravel	10 (2,000)	0	0	0	0.1	0.2	0	0.4	0.1	0	0	0	0	0
Coarse sand	18 (1000)	0.2	0.1	0.4	0.5	0.2	0.6	0.5	1.1	0.2	0.4	0.5	0.7	0.7
Coarse sand	30 (500)	0.6	0.4	0.4	1.2	0.4	0.6	1.3	2.6	0.6	0.5	1.2	1.0	0.8
Medium sand	100 (147)	6.8	8.0	6.8	14.3	9.5	19.6	18.0	29.4	50.7	28.8	16.7	35.0	41.2
Fine sand	200 (75)	1.9	80.8	82.0	73.1	78.5	73.5	65.5	32.0	44.0	68.5	76.9	62.3	56.8
Silt	Pan (<75)	90.5	10.7	10.4	10.8	11.2	5.7	14.3	34.8	4.5	1.8	4.7	1.0	0.5

(a) Opening size (μm) is given in parentheses.

TABLE 10 CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN WATER SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Chemical Constituent	Station 1		2		3		4		5		6		7	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Cadmium[a]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead[a]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury[a]	<0.002	<0.002	<0.002	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	0.005	<0.002	<0.002	<0.002
Zinc[a]	<0.1	<0.1	--	--	<0.1	<0.1	--	--	<0.1	<0.1	--	--	--	--
Copper[a]	<0.08	<0.08	--	--	<0.08	<0.08	--	--	<0.08	<0.08	--	--	--	--
Phenols[a]	<0.004	<0.004	--	--	<0.004	<0.004	--	--	<0.004	<0.004	--	--	--	--
Oil & Grease[a] (Freon extractable)	<1	<1	--	--	<1	<1	--	--	<1	<1	--	--	--	--
Chlorinated hydrocarbons[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

(a) Unit ppm; detection limit: cadmium, 0.1; copper, 0.08; lead, 0.3; mercury, 0.002; zinc, 0.1; phenols, 0.004; oil & grease, 1.
(b) Unit ppb: detection limit: chlorinated hydrocarbons, 0.1; polychlorinated biphenyls, 0.5.

Note: -- means chemical analysis was not performed on that sample.

TABLE 11 CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN SEDIMENT SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Chemical Constituent	Field Blank	Station												
		Disposal Site							Reference Site					
		1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Cadmium[a]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Lead[a]	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Mercury[a]	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Zinc[a]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper[a]	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.03	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Phenols[a]	<0.004	<0.004	<0.004	<0.004	<0.004	0.005	0.005	<0.004	<0.004	<0.004	<0.004	0.004	<0.004	0.004
Oil & Grease[a] (Freon extractable)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorinated hydrocarbons[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls[b]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

(a) Unit ppm; detection limit: cadmium, 0.1; copper, 0.08; lead, 0.3; mercury, 0.002; zinc, 0.1; phenols, 0.004; oil and grease, 1.
(b) Unit ppb; detection limit: chlorinated hydrocarbons, 0.1; polychlorinated biphenyls, 0.5.

Note: -- means chemical analysis was not performed on that sample.

TABLE 12 CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN WATER SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Chemical Constituent	Stations 1		2		3		4		5		6		7	
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom
Cadmium[a]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper[a]	0.017	0.003	--	--	0.007	0.018	--	--	0.330	0.010	--	--	--	--
Lead[a]	0.008	0.002	0.002	0.008	0.002	0.005	0.004	0.001	0.008	0.004	0.002	0.002	0.021	0.006
Mercury[a]	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Zinc[a]	0.02	0.01	--	--	<0.01	0.01	--	--	<0.01	0.01	--	--	--	--
Phenols[a]	0.002	0.008	--	--	0.002	0.016	--	--	0.002	0.009	--	--	--	--
Oil & Grease[a] (Freon extractable)	<5	<5	--	--	<5	<5	--	--	<5	<5	--	--	--	--
Chlorinated hydrocarbons[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

(a) Unit ppm; detection limit: cadmium, 0.001; copper, 0.001; lead, 0.001; mercury, 0.0001; zinc, 0.01; phenols, 0.001; oil & grease 5.
(b) Unit ppb; detection limit: chlorinated hydrocarbons, 0.1; polychlorinated biphenyls, 0.1.

Note: -- means chemical analysis was not performed on that sample.

TABLE 13 CONCENTRATIONS OF CHEMICAL CONSTITUENTS IN SEDIMENT SAMPLES COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Chemical Constituents	Station												
	Disposal Site							Reference Site					
	1	2	3	4	5	6	7	R-1	R-2	R-3	R-4	R-5	R-6
Cadmium[a]	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper[a]	0.001	0.001	0.013	0.001	0.001	0.001	0.007	0.010	0.075	0.035	0.004	0.003	0.005
Lead[a]	<0.001	<0.001	0.008	0.003	<0.001	<0.001	0.003	0.003	0.004	0.003	0.005	0.003	0.004
Mercury[a]	0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.0002	<0.0001	0.0003	0.0004	<0.0001	<0.0001	0.0002	<0.0001
Zinc[a]	<0.01	<0.01	0.08	<0.01	<0.01	<0.01	<0.01	0.01	0.10	0.03	0.02	0.02	0.07
Phenols[a]	0.014	0.018	<0.001	<0.001	0.003	0.005	0.009	0.010	<0.001	0.015	0.002	<0.001	<0.001
Oil & Grease[a] (Freon extractable)	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Chlorinated Hydrocarbons[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Polychlorinated biphenyls[b]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

(a) Unit ppm; detection limit: cadmium, 0.001; copper, 0.001; lead, 0.001; mercury, 0.0001; zinc, 0.01; phenols, 0.001; oil and grease, 5.
(b) Unit ppb; detection limit: chlorinated hydrocarbons, 0.1; polychlorinated biphenyls, 0.1.

Note: -- means chemical analysis was not performed on that sample.

to protect saltwater aquatic life from inorganic mercury (44 FR 56653, 1 October 1979).

3.3 BIOLOGICAL SURVEYS

The zooplankton, benthic, and epibenthic surveys resulted in the collection of both a large number of taxa and a large number of organisms within each taxon. A total of 106 zooplankton, 172 benthic, and 49 epibenthic taxa were identified in the two surveys.

The concentration of total chlorophyll was lower in the fall survey than in the summer survey (Tables 14 and 15). In the summer, surface chlorophyll levels ranged between 3.3 and 11.4 mg/m^3 overall; in the fall, they ranged between 0.5 and 0.65 mg/m^3 overall.

A total of 65 taxa of zooplankton were collected and identified in the summer survey (Table 16). The copepods *Calanus pacificus* and *Pseudocalanus elongatus* were the most abundant at densities averaging $12/m^3$ and $5.9/m^3$, respectively. As with chlorophyll concentrations, the zooplankton densities in the fall survey were lower than the densities found in the summer survey (Table 17). An additional 41 taxa of zooplankton were identified in the fall survey, with the copepods *Acartia tonsa* and *Calanus pacificus* occurring in the greatest densities, $0.23/m^3$ and $0.25/m^3$, respectively.

More than 5,300 organisms from 127 taxa were collected in benthic samples at the proposed disposal site in the summer survey (Table 18). In the fall survey an additional 45 taxa were collected and identified (Table 19). The most abundant organism collected in both summer and fall surveys was the polychaete *Owenia collaris*, followed by the gastropod *Olivella pycna* and the bivalve *Epilucina californica*. The densities of most benthic organisms were similar in the summer and fall surveys, except for *Owenia collaris*, whose average density increased from 23/grab sample in summer to 315/grab sample in fall.

More than 17,000 epibenthic organisms from 38 taxa were collected in otter trawls during the summer survey (Table 20). The most abundant species collected were Dungeness crab (*Cancer magister*), Pacific tomcod (*Microgadus proximus*), and night smelt (*Spirinchus starksi*). Although 11 additional taxa were identified in the fall survey, the overall abundance of fish was lower in fall than in summer (Table 21). The abundance of invertebrates in the fall collection was greater than in summer, with the decapods *Crangon alaskensis elongata* and *Cancer magister* the most abundant.

TABLE 14 TOTAL CHLOROPHYLL CONCENTRATIONS (mg/m^3) AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Time	Station 1	3	5	6	7
Day	3.3	6.1	4.9	5.3	5.7
Night	9.9	5.4	11.4	5.9	8.4

TABLE 15 TOTAL CHLOROPHYLL CONCENTRATIONS (mg/m^3) AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

	Station				
Time	1	3	5	6	7
Day	0.46	0.65	<0.05	0.09	<0.05
Night	<0.05	<0.05	0.05	0.10	0.20

TABLE 16 TAXONOMIC LIST AND ABUNDANCES (no./1,000 m^3) OF ZOOPLANKTON COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night	Station 5 Day	Station 5 Night	Station 6 Day	Station 6 Night
Cnidaria												
Hydrozoa												
Hydroida (medusae)			10				150					
Siphonophora												
Scyphozoa						260						
Chrysaora melanaster												
Ctenophora												
Pleurobrachia bachei											5	
Annelida												
Oligochaeta			3									
Polychaeta (juveniles)	180			350	3	230				460		20
Magelona pitelkai		3										
Polynoidae												
Syllidae												
Autolytus sp.												
Hirudinea												
Piscicolidae												37
Arthropoda												
Copepoda (unidentified)				500	80		210		2,840	40		300
Calanoida (nauplii)			10	500		450						
Calanoida (copepodites)					3					40		
Calanoida (unidentified)												
Calanoida (mutilated)												
Acartia sp. (mutilated)												
Acartia pacifica												
Paracalanus parvus												
Rhincalanus nasutus												
Acartia clausi	930	520	100	660	200	690	1,250	240	140	270	90	960
Acartia longiremis		170	50		20			50	140	420	10	20
Acartia tonsa			20		20							
Epilabidocera longipedata					3					40	10	
Pseudocalanus elongatus	21,780	11,620	640	4,110	190	6,860	1,390	950	13,620	6,020	530	3,360
Tortanus discaudatus		180								40	2	
Centropages abdominalis			10		7						5	
Centropages tenuiremis											3	
Metridia pacifica			10			260		50		190	10	20
Calanus pacificus	37,040	24,130	3,270	7,390	1,540	10,080	16,420	7,640	33,620	2,800	1,240	4,540
Oithona plumifera					3							
Harpacticoida												
Corycaeus anglicus												
Branchiopoda												
Cladocera												
Evadne nordmanni	620	180	860	1,200	530	1,820	1,550	980	570	840	420	210
Podon polyphemoides	4,320	11,280	3,420	12,180	2,790	13,970	5,710	3,420	7,660	7,150	2,220	4,010
Cirripedia (nauplii)	20,400	38,700	3,880	66,850	980	36,130	14,310	11,030	8,230	33,180	600	16,160
Cirripedia (cyprid)	1,230	5,800	160	3,780	800	17,880	830	330	1,130	19,690	40	2,080

TABLE 16 (CONT.)

Taxon	Station 1 Day	1 Night	2 Day	2 Night	3 Day	3 Night	4 Day	4 Night	5 Day	5 Night	6 Day	6 Night
Malacostraca												
Cumacea (unidentified)		180	10							40		90
Diastylopsis sp.												
Diastylopsis dawsoni					460					310		
Diastylopsis tenuis				500								210
Mesolamprops dillonensis				330								80
Mysidacea (juveniles)					3			50		80	5	2,540
Mysidacea (mutilated)												
Neomysis rayii	250			170							3	859
Acanthomysis columbiae											3	60
Acanthomysis macropsis											3	40
Acanthomysis sculpta												90
Amphipoda												
Gammaridea												
Ischyrocerus sp.												
Parapleustes pugettensis												
Monoculoides spinipes												370
Atylus tridens						230	140					
Caprellidea												
Caprella alaskana												
Hyperiidea												
Hyperia medusarum			30									
Hyperoche sp.								30				
Isopoda												
Synidotea bicuspida												
Eucarida												
Euphausiacea (calyptopis)	3,140	1,470	1,290	1,480	230	13,230	1,810	850	13,620	11,900	290	380
Euphausiacea (furcilia)	1,050	3,880	50	490	20	470	140	270	850	730	60	60
Decapoda												
Caridea				170	10							40
Hippolytidae												
Hippolytidae Type 1	610	170	20	820		230	150			150	30	250
Hippolytidae Type 2	250				3					40		20
Crangonidae Type 1	180		3	330	10	230	140	70			10	40
Crangonidae Type 2					3			60			3	
Crangonidae (mutilated)												
Crangon franciscorum												
Alpheidae (1)					3							20
Brachyura (zoeae)					3							
Cancer gracilis (megalopae)												
Cancer sp. 1 (zoeae)												
Cancer antennarius (zoeae)												
Cancer productus (zoeae)			3									40
Cancer magister (megalopae)			3									
Cancer oregonensis (zoeae)												20
Xanthidae (zoeae)			3			30				40	3	
Pinnotheridae (zoeae)			6		3						5	
Pinnixa sp. (megalopae)												

TABLE 16 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night	Station 5 Day	Station 5 Night	Station 6 Day	Station 6 Night
Majidae (zoeae)	180		3									
Pugettia gracilis (megalopae)												
Anomura												
Callianassidae												
Callianassa sp.			3	170				30				40
Paguridae												
Pagurus sp. 1	180	180		490	20	450				40	5	130
Pagurus sp. 2	180		3					50				40
Hippidae												
Emerita analoga											3	
Porcellanidae (zoeae)												
Mollusca												
Gastropoda			3							120	5	
Gastropoda Type 1												
Gastropoda Type 2												
Gastropoda Type 3												
Gastropoda Type 4												
Gastropoda Type 5												
Bivalvia												
Phoronida					3					40		
Nemertea												
Chaetognatha (unidentified)	250											
Sagitta sp.			3	170								
Sagitta euneritica		350	80	160	3		150	80		80	20	20
Echinodermata (larvae)												
Echinoidea (juveniles)												
Chordata												
Urochordata												
Thaliacea												
Larvacea												
Oikopleura sp.			50		3			20		150	10	
Osteichthyes (eggs)	180		40		3					40	3	
Osteichthyes Type 53									140			
Osmeridae Type 1			3									19
Parophrys vetulus												

TABLE 17 TAXONOMIC LIST AND ABUNDANCES (no./1,000 m^3) OF ZOOPLANKTON COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night	Station 5 Day	Station 5 Night	Station 6 Day	Station 6 Night
Cnidaria												
Hydrozoa												
Hydroida (medusae)	2.68	2.5										4.7
Siphonophora									2.5			
Scyphozoa												
Chrysaora melanaster					0.03		0.03					0.04
Ctenophora		4.5				2.3						
Pleurobrachia bachei	2.68			7.7				2.3				
Annelida												
Oligochaeta												
Polychaeta (juveniles)						4.5		7.2		2.3		
Magelona pitelkai												
Polynoidae				2.57								
Syllidae				2.57								
Autolytus sp.				2.2								
Hirudinea												
Piscicolidae												
Arthropoda												
Copepoda (unidentified)												
Calanoida (nauplii)												
Calanoida (copepodite)												
Calanoida (unidentified)					1.9	11.5				4.4	4.7	7.1
Calanoida (mutilated)	26.45	31.2	43.8	7.7	15.8	60.9	25.3	7.1	29.8		87.9	
Acartia sp. (mutilated)		7.6		7.7					10.0			
Acartia pacifica	39.29	84.5	329.2	27.6	13.9	116.0	31.3	30.7		68.3	78.2	31.2
Paracalanus parvus	209.13	207.2	411.2	193.8	167.9	213.5	174.7	204.9	175.4	295.2	366.9	176.7
Rhincalanus nasutus	2.97		7.1	4.9	8.0		4.1		10.0	2.3	6.9	
Acartia clausi	14.56	22.8	5.0			2.3	6.3	32.8			15.5	
Acartia longiremis	28.85	69.7	86.9	61.4	34.0	68.6	38.3	68.4	54.1	45.8	88.7	69.7
Acartia tonsa	111.33	227.2	222.4	451.0	339.8	323.3	221.8	226.6	208.7	340.1	419.2	353.4
Epilabidocera longipedata			4.8	2.5				2.3			6.7	4.7
Pseudocalanus elongatus	142.29	90.0	214.9	47.4	149.9	57.4	144.8	63.7	265.2	76.5	376.2	69.7
Tortanus discaudatus	116.34	142	63.4	58.3	389.7	124.4	360.3	105.0	60.6	190.5	95.5	128.4
Centropages abdominalis											4.7	
Centropages tenuiremis												
Metridia pacifica	98.14	199.6	91.4	133.2	117.9	277.3	130.9	25.7	97.7	63.8	108.8	91.4
Calanus pacificus	14.28	461.3	53.7	321.2	41.9	396.3	79.4	499.4	112.0	412.1	111.2	542.8
Oithona plumifera												
Harpacticoida	5.94	9.8	13.9	10.2								
Corycaeus anglicus	36.89	75.1	61.3	156.0	17.9	144.6	31.7	112.3	10.0	160.6	40.4	90.7
Branchiopoda												
Cladocera												
Evadne nordmanni	2.68	5.1	7.5	2.5	2.1		2.2	7.2	2.5	4.2	13.5	4.7
Podon polyphemoides	2.97					2.3	2.2		2.5		2.2	
Cirripedia (nauplii)	5.65	6.8	7.1		16.0	13.9	6.3	4.7	5.1	4.4	4.4	2.4
Cirripedia (cyprid)	8.62		12.3	12.8	14.0	6.9	19.1	4.8	5.0	4.4	54.5	14.3

TABLE 17 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night	Station 5 Day	Station 5 Night	Station 6 Day	Station 6 Night
Malacostraca												
Cumacea (unidentified)	3.0	25.3										
Diastylopsis sp.		2.5										
Diastylopsis dawsoni		25.9										
Diastylopsis tenuis		12.2		17.6		2.2						4.7
Mesolamprops dillonensis	2.7	21.8		20.5		2.3		2.4		2.1		2.4
Mysidacea (juveniles)												
Mysidacea (mutilated)			2.3									
Neomysis rayii												2.4
Acanthomysis columbiae		2.3	2.5									
Acanthomysis macropsis				4.1			2.2			2.2		
Acanthomysis sculpta												
Amphipoda												
Gammaridea			2.5		2.0						2.4	
Ischyrocerus sp.				2.6								
Parapleustes pugettensis											2.4	
Monoculoides spinipes												
Atylus tridens					1.9							
Caprellidea												
Caprella alaskana	3.0											
Hyperiidea				5.2								
Hyperia medusarum												
Hyperoche sp.				2.6						4.4		
Isopoda												
Synidotea bicuspida										2.3		
Eucarida												
Euphausiacea (calyptopis)	8.3	4.5	2.5	2.6	1.9		2.2	2.4	2.5			2.4
Euphausiacea (furcilia)			2.5	2.5		4.5		2.3		4.2		
Decapoda												
Caridea							2.2					
Hippolytidae				2.6								
Hippolytidae Type 1												
Hippolytidae Type 2												
Crangonidae Type 1	5.4	2.5		4.9	7.9		10.3	2.4		4.2	4.5	31.1
Crangonidae Type 2									2.5			
Crangonidae (mutilated)									2.5			
Crangon franciscorum		7.6										
Alpheidae (1)				2.6								
Brachyura (zoeae)				2.5								
Cancer gracilis (megalopae)		2.5					6.4					2.3
Cancer sp. 1 (zoeae)			2.3									
Cancer antennarius (zoeae)							2.2					
Cancer productus (zoeae)												
Cancer magister (megalopae)												
Cancer oregonensis (zoeae)												
Xanthidae (zoeae)		2.5										
Pinnotheridae (zoeae)	11.3	12.2	12.1	42.8	43.9	11.5	29.5	7.2	15.0	8.8	11.3	50.5
Pinnixa sp. (megalopae)		2.5										

TABLE 17 (CONT.)

Taxon	Station 1 Day	1 Night	2 Day	2 Night	3 Day	3 Night	4 Day	4 Night	5 Day	5 Night	6 Day	6 Night
Majidae (zoeae)		5.1	4.6	10.0		2.2				6.3	2.4	21.5
Pugettia gracilis (megalopae)								2.4				
Anomura												
Callianassidae												
Callianassa sp.	5.6	56.8	2.5	120.2	7.9	64.2	6.3	39.9	12.5	138.6	2.2	4.7
Paguridae												
Pagurus sp. 1	3.0		2.3			2.3					2.2	
Pagurus sp. 2		17.7	6.9	45.7	7.9	20.8	10.5	4.7		19.8		9.4
Hippidae												
Emerita analoga	3.0		7.3	12.6	2.1	9.2	4.2		2.5	4.2		4.8
Porcellanidae (zoeae)	3.0	2.3	2.5	12.6	29.9	2.3	52.9	2.3	9.9		27.1	19.2
Mollusca												
Gastropoda												
Gastropoda Type 1	20.5	4.8	22.4	2.5	30.0	32.4	10.7	11.7	80.0	23.8	30.3	12.0
Gastropoda Type 2	8.9	4.8	36.3	53.6	37.8	2.3	10.9		50.1	13.3	50.6	2.3
Gastropoda Type 3		10.1		10.3	34.0	2.3	4.4	4.6		10.9		2.3
Gastropoda Type 4	10.7	2.5		5.0	16.0	4.4	12.8	7.0		29.2	16.4	7.2
Gastropoda Type 5	8.0		2.3	2.5			2.0					4.8
Bivalvia						4.5						
Phoronida												
Nemertea				2.6								
Chaetognatha (unidentified)												
Sagitta sp.												
Sagitta euneritica	77.3	222.7	59.4	126.4	79.9	267.9	91.2	236.5	110.1	262.0	194.1	114.9
Echinodermata (larvae)						6.8				2.1	2.2	
Echinoidea (juveniles)								2.3		2.3		
Chordata												
Urochordata												
Thaliacea	2.7			2.6	2.1	2.3		2.3		8.4		
Larvacea												
Oikopleura sp.	54.2	51.7	50.8	43.5	25.9	37.1	29.8	20.9	44.5	65.9	81.1	38.4
Osteichythes (eggs)												
Osteichythes Type 53												
Osmeridae Type 1												
Parophrys vetulus		2.5										

TABLE 18 TAXONOMIC LIST AND NUMBERS OF BENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Taxon	Station 1	2	3	4	5	6	7
Cnidaria							
Anthozoa							
Actiniaria	1	2	1		1	8	
Metridium senile					1		
Scyphozoa							
Stauromedusae			1			1	
Platyhelminthes							
Nemertea							
Annelida							
Polychaeta (unidentified)	16	21	11				
Ampharetidae	3	8	1	3		5	
Ampharete acutifrons							
Aphroditidae							
Aphrodita parva	1						
Capitellidae					1	1	
Mediomastus californiensis	7	56	12	4	5	40	
Chaetopteridae	1	2			1		
Spiochaetopterus costarum							
Cirratulidae	1	1	1	1		1	
Chaetozone setosa	1	5	18	7	1	15	
Cirratulus cirratus	1						
Tharyx sp.	2						
Tharyx multifilis	26	30	8	12	3	12	
Glyceridae	1		1	2			
Glycera convoluta	1	2	1	8	2	10	
Goniadidae							
Glycinde polygnatha	17	79	40	21	15	54	
Lumbrineridae							
Lumbrineris tetraura	23	63	74	58	6	50	
Lumbrineris zonata							

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Magelonidae							
Magelona pitelkai	9		16	14		5	
Magelona sacculata							
Hesionidae							
Gyptis arenicola							
Scalibregmidae							
Scalibregma inflatum							
Nephtyidae							
Nephtys sp.	1	4					
Nephtys caecoides	53	27	42	19	3	42	
Nephtys parva							
Nereidae			2			2	
Onuphidae							
Nothria elegans	39	39	9	15		36	
Orbiniidae		2	6	1		1	
Haploscoloplos elongatus	20	63	18	16	9	39	
Naineris sp.							
Naineris uncinata	1		2	1		1	
Phylo felix	1	14	5	16		20	
Oweniidae		14	5				
Myriochele pygidialis	4	30		1		2	
Owenia collaris	92	701	1	16	3	2	
Phyllodocidae	2	2				2	2
Eteone sp.			1				
Eteone californica							
Eteone dilatae							
Anaitides williamsi	2	3	3	2		8	
Polynoidae	3			1		2	
Lepidasthenia longicirrata	1						
Malmgrenia nigralba							
Sabellidae				5	1		2
Sabella crassicornis	2				1		1

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7		
Sigalionidae									
Pholoe tuberculata		4	21	1			11		
Sthenelais verruculosa									
Thalenessa sp.		13	2	4	9		10		
Spionidae									
Laonice sp.		1							
Laonice cirrata									
Polydora sp.		1							
Prionospio pinnata									
Prionospio steenstrupi									
Spiophanes berkeleyorum				12	24	10	85		
Spiophanes bombyx		16		19	83	1	19		
Syllidae					2		1	1	
Typosyllis aciculata									
Typosyllis adamanteus									
Terebellidae			4				1		2
Amaeana occidentalis									
Flabelligeridae									
Pherusa sp.									
Pherusa papillata									
Arthropoda									
Pycnogonida									
Cirripedia			4						
Malacostraca									
Cumacea		1				1	1		
Diastylis sp.		2	8	1	1	1	21		
Diastylopsis sp.						73	1		
Diastylopsis dawsoni		9	25	17	13	21	106		
Diastylopsis tenuis		4	3	7	47	1	11	1	
Mesolamprops sp.					4				

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Isopoda		1					
Edotea sublittoralis							
Tecticeps convexus							
Synidotea biscuspida	3	3	1	1		21	
Munna sp.						5	
Amphipoda							
Gammaridea (unidentified)	3	23	4	8	2	15	
Ampelisca sp.	6	1				1	
Ampelisca agassizi	20	9					
Ampelisca macrocephala	41	2	30	17		30	
Cymadusa uncinata						1	2
Dulichia sp.			1				
Eohaustorius sp.				23			
Ischyrocerus sp.		7		1	3		2
Maera vigota				2			
Monoculodes spinipes				5	1		
Paraphoxus epistomus	38	11	13	48	1	16	
Paraphoxus cognatus							
Paraphoxus spinosus							
Paraphoxus tridentatus							
Protomedia sp.							
Parapleustes pugettensis					15		11
Photis bifurcata					1		
Photis brevipes		1				8	
Photis californica	2	4				2	
Photis conchicola	1	4		2			
Photis sp.	5			8	2	21	2
Pleusymptes subglaber	1	2					
Synchelidium shoemakeri							
Tiron biocellata							
Megamphopus effrenus							
Hippomedon denticulatus							
Gammaridea caprellidea							
Caprella laeviuscula	1						

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Decapoda							
Anomura							
Paguridae		1		1	1		
Pagurus beringanus				1	17		2
Callianassidae	2	1					
Upogebia pugettensis							
Porcellanidae							
Brachyura							
Cancer antennarius (Megalopa)							
Cancer magister	3		2	44	2		
Loxorhynchus crispatus					1		
Pinnotheridae		4		1		1	
Scleroplax granulata							
Pinnixa sp.	1					3	
Caridea							
Crangon stylirostris							
Heptacarpus sp.					1		
Heptacarpus brevirostris					1		1
Mollusca							
Polyplacophora							
Mopalia sp.					2		
Gastropoda		1					1
Prosobranchia							1
Calliostoma ligatum							1
Epitonium tinctum	2						
Mitrella sp.		1			1		
Mitrella gouldi	12	7	28			25	1
Nassarius fossatus				1			
Nassarius mendicus					2		1
Nassarius perpinguis	3		19	5			
Olivella pycna	14	5	73	524		4	
Amphissa sp.					1		1
Trichotropis cancellata					1		

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Fasciolaridae							
Fusinus sp.							
Opisthobranchia	1					1	
Cylichna sp.	14	4				1	
Diaphana californica		4		1		2	
Odostomia sp.	5	2				1	
Turbonilla sp.	4	1					
Gymnostomata		2	1			3	
Bivalvia (unidentified)		3				3	
Nucula sp.							
Mactra sp.							
Siliqua patula							
Nuttallia nuttallii							
Chlamys hastata							2
Epilucina californica	168	145	4	3		71	
Lyonsia californica	1						
Mytilidae	1						
Veneridae							
Protothaca staminea				2	2		
Tellinidae	2		2	8		15	
Macoma sp.	1						
Macoma acolasta				1	1		
Macoma yoldiformis							
Tellina sp.							
Tellina modesta	7	13	24	35	1	1	
Echinodermata							
Echinoidea	9	1			1	12	
Dendraster excentricus							
Ophiuroidea	6		2	8		3	2
Amphipholis squamata					1		
Holothuroidea							
Cucumaria lubrica					1		
Eupentacta quinquesemita	27						

TABLE 18 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Ectoprocta					P[(a)]		P[(a)]
Phoronida	4			2	1	3	
Nematoda		1					
Chaetognatha							
Sagitta sp. (mutilated)							
Nemertea	8	28	14	34	3	5	
Paleonemertea		7					
Heteronemertea		1					
Sipuncula	3	1	2	3			
Chordata							
Urochordata							
Ascidiacea					P[(a)]		P[(a)]

(a) P = present (usually a colonial form).

TABLE 19 TAXONOMIC LIST AND NUMBERS OF BENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Taxon	Station 1	2	3	4	5	6	7
Cnidaria							
Anthozoa							
Actiniaria							
Metridium senile							
Scyphozoa							
Stauromedusae							
Platyhelminthes							1
Nemertea	70	70	5	6	33	12	8
Annelida							
Polychaeta (unidentified)							
Ampharetidae							
Ampharete acutifrons	17	13	7	20	1	2	14
Aphroditidae							
Aphrodita parva							
Capitellidae							
Mediomastus californiensis	50	167	8	38		3	11
Chaetopteridae							
Spiochaetopterus costarum	4	2			4		
Cirratulidae				2		1	
Chaetozone setosa	29	111	107	24	22	17	56
Cirratulus cirratus							
Tharyx sp.	12	63	7	4			
Tharyx multifilis	16		7	24	4	3	28
Glyceridae							
Glycera convoluta		2	5	6	4	4	9
Goniadidae							
Glycinde polygnatha	60	101	62	46	47	38	22
Lumbrineridae							
Lumbrineris tetraura	90	93	59	55	7	30	37
Lumbrineris zonata		1					

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Magelonidae							
Magelona pitelkai	35	59	7	15	11	3	25
Magelona sacculata	1	4	5	20	105	17	8
Hesionidae							
Gyptis arenicola		1					
Scalibregmidae							
Scalibregma inflatum				1			
Nephtyidae							
Nephtys sp.							
Nephtys caecoides	11	10	23	29	11	22	20
Nephtys parva	7	7	5	25	16	19	9
Nereidae							1
Onuphidae							
Nothria elegans	47	92	38	27	3	15	13
Orbiniidae			1				
Haploscoloplos elongatus	82	77	78	17	18	15	21
Naineris sp.							1
Naineris uncinata		3	2	1			2
Phylo felix		12	2	9	1	2	5
Oweniidae						9	
Myriochele pygidialis							
Owenia collaris	5,294	2,526	611	1,271	20	1,254	80
Phyllodocidae							
Eteone sp.							
Eteone californica	5	14	1	5	4	3	19
Eteone dilatae	4		1	1		1	1
Anaitides williamsi	4	4		3	5	2	
Polynoidae							
Lepidasthenia longicirrata							
Malmgrenia nigralba		5	1	1		2	2
Sabellidae							
Sabella crassicornis							

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Sigalionidae							
Pholoe tuberculata	18	25	8	2	1		1
Sthenelais verruculosa	23	20	6	12	2	18	6
Thalenessa sp.							
Spionidae	1			1			
Laonice sp.							
Laonice cirrata	4	3	1	1			
Polydora sp.							
Prionospio steenstrupi							1
Prionospio pinnata				1			
Spiophanes berkeleyorum	1	20			11	1	1
Spiophanes bombyx	14	46	16	71	264	76	115
Syllidae							
Typosyllis aciculata		1		1			
Typosyllis adamanteus							1
Terebellidae							
Amaeana occidentalis	8	9	3			1	3
Flabelligeridae							
Pherusa sp.	7	1	2				
Pherusa papillata				1			
Arthropoda							
Pycnogonida		1					
Cirripedia							
Malacostraca							
Cumacea	2	1					
Diastylis sp.	4	2		1		2	
Diastylopsis sp.		1					
Diastylopsis dawsoni	65	110	32	48	152	30	10
Diastylopsis tenuis	181	211	67	224	138	120	58
Mesolamprops sp.	3	1	1	1		10	1

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Isopoda							
Edotea sublittoralis	4	2				3	
Tecticeps convexus	13	1	1				
Synidotea biscuspida	17	1		3		8	
Munna sp.							
Amphipoda							
Gammaridae (unidentified)							1
Ampelisca sp.							
Ampelisca agassizi	8	1	2	1	1	1	1
Ampelisca macrocephala	27	22	13	5	4		14
Cymadusa uncinata							
Dulichia sp.							
Eohaustorius sp.							
Ischyrocerus sp.	4						
Maera vigota							
Monoculodes spinipes	5		3	2		1	
Paraphoxus epistomus	5	3	5	6	54	3	7
Paraphoxus cognatus		1		2			
Paraphoxus spinosus				1	1		
Paraphoxus tridentatus				1		6	
Protomedia sp.				5			
Parapleustes pugettensis							
Photis bifurcata							
Photis brevipes	1	7		1		1	
Photis californica		2					
Photis conchicola							1
Photis sp.	5	10		6		9	1
Pleusymptes subglaber							
Synchelidium shoemakeri	2	5	2	2			
Tiron biocellata					1	1	
Megamphopus effrenus		3	1	4			
Hippomedon denticulatus				1			
Gammaridea caprellidea							
Caprella laeviuscula							

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Decapoda							
Anomura							
Paguridae	4		1				
Pagurus beringanus		1		1			
Callianassidae							
Upogebia pugettensis		9	2	1			
Porcellanidae						1	
Brachyura							
Cancer antennarius (Megalopa)	4					1	
Cancer magister							
Loxorhynchus crispatus							
Pinnotheridae		2					
Scleroplax granulata						1	
Pinnixa sp.							
Caridea							
Crangon stylirostris		1				1	
Heptacarpus sp.							
Heptacarpus brevirostris							
Mollusca							
Polyplacophora							
Mopalia sp.							
Gastropoda							
Prosobranchia	1	1		5	1	1	1
Calliostoma ligatum							
Epitonium tinctum	1		1				
Mitrella sp.							
Mitrella gouldi	28	4	4	6		13	11
Nassarius fossatus	4	1			1		
Nassarius mendicus							
Nassarius perpinguis	1	2					3
Olivella pycna	149	168	30	104	8	98	77
Amphissa sp.							
Trichotropis cancellata							

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Fasciolaridae				1		1	
Fusinus sp.				3		2	1
Opisthobranchia							
Cylichna sp.	13	11	7	3		5	3
Diaphana californica		4					
Odostomia sp.	16	7	2	2		1	
Turbonilla sp.			1	1		1	
Gymnostomata							
Bivalvia (unidentified)		4					
Nucula sp.	16	19	2	1			
Mactra sp.	32	4		8	1	10	1
Siliqua patula	8	5		3		1	
Nuttallia nuttallii				1			
Chlamys hastata							
Epilucina californica	279	140	48	8		13	11
Lyonsia californica	4					7	
Mytilidae	10	4	18	9	6	8	5
Veneridae	4						
Protothaca staminea							
Tellinidae	7	1	4	4			
Macoma sp.	5	1		6		7	
Macoma acolasta							
Macoma yoldiformis				2	7	9	
Tellina sp.	1						
Tellina modesta	4	11	13	10	19	11	2
Echinodermata							
Echinoidea			4	8	2	240	
Dendraster excentricus				50	1	151	1
Ophiuroidea	51	24	9	22	8	121	1
Amphipholis squamata							
Holothuroidea							
Cucumaria lubrica							
Eupentacta quinquesemita	14	11	15	1		2	

TABLE 19 (CONT.)

Taxon	Station 1	2	3	4	5	6	7
Ectoprocta							
Phoronida		4		1			2
Nematoda							
Chaetognatha							
Sagitta sp. (mutilated)		1				1	1
Nemertea							
Paleonemertea							
Heteronemertea							
Sipuncula							
Chordata							
Urochordata							
Ascidiacea							

Note: Three samples from Station 1 were split to ¼.

TABLE 20 TAXONOMIC LIST AND ABUNDANCES OF EPIBENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, JUNE 1979

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Chordata								
Pisces								
Agnatha								
Cyclostomata								
Eptatretus stoutii			1	1				
Chondrichthyes								
Hydrolagus colliei				2				
Squalus acanthias					1			
Raja binoculata	2			2		3	4	5
Osteichthyes								
Teleostei								
Microgadus proximus	1,775	91	439	117	200	240	251	748
Spirinchus starksi	490	5	305		1,780	146	569	178
Sebastes flavidus	384	177	232	88	673	98	259	251
Citharichthys stigmaeus	20	151	91	91	41	254	59	187
Isopsetta isolepis	15	24	74	62	47	58	46	44
Parophrys vetulus	9	12	35	26	24	30	46	30
Stellerina xyosterna	3	3		2	13	29		43
Ophiodon elongatus	3	1	11	2	1	1	7	1
Liparis pulchellus	2			5	2	7	7	24
Pleuronichthys decurrens	2		1		4		1	1
Artedius sp.	3			1	2			2
Platichthys stellatus			1	2	1		1	
Sebastes entomelas		1	1		2		1	
Sebastes paucispinis			1		2			1
Leptocottus armatus			1	1			1	
Engraulis mordax	1				5			
Citharichthys sordidus								
Occella verrucosa								
Allosmerus elongatus								
Cymatogaster aggregata								
Hyperprosopon anale								

TABLE 20 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Paralichthys californicus								
Syngnathus sp.								
Clupea harengus pallasi	1							2
Psettichthys melanostictus	1	1	7	2	1	1	2	1
Sebastes sp.				1		1		
Pholis ornata			1					
Icichthys lockingtoni	1							
Cottidae (unidentified)				1				
Cnidaria								
Chrysaora melanaster								
Annelida								
Polychaeta (unidentified)						1		
Arthropoda								
Crustacea								
Isopoda								
Lironeca vulgaris	1							
Decapoda								
Caridea								
Pandalus danae	12	3	3	4	1		1	
Crangon franciscorum		11		1	1	6	2	
Crangon alaskensis elongata				8	1	2	1	
Crangon nigromaculata								
Brachyura								
Cancer magister	188	5,800	3	16	342	50	12	331
Cancer gracilis							2	
Anomura								
Pagurus beringanus	1	3		5		2		

TABLE 20 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Mollusca								
Cephalopoda								
Octopus sp.								
Loligo opalescens	8	1	11		7		19	
Gastropoda								
Nassarius perpinguis						4		
Echinodermata								
Asteroidea								
Pisaster brevispinus	1				6		1	5
Pycnopodia helianthoides	4	4		1	3			
Dermasterias imbricata		1			2			
Luidia foliolata							1	
Holothuridea								
Eupentacta quinquesemita								

TABLE 21 TAXONOMIC LIST AND ABUNDANCES OF EPIBENTHIC ORGANISMS COLLECTED AT THE PROPOSED CRESCENT CITY HARBOR DREDGED MATERIAL DISPOSAL SITE, NOVEMBER 1979

Taxon	Station 1		2		3		4	
	Day	Night	Day	Night	Day	Night	Day	Night
Chordata								
Pisces								
Agnatha								
Cyclostomata								
Eptatretus stoutii								
Chondrichthyes								
Hydrolagus colliei								
Squalus acanthias								
Raja binoculata		4	6	4	2	8	4	5
Osteichthyes								
Teleostei								
Microgadus proximus	115	329	133	215	259	696	168	162
Spirinchus starksi	52	71	218	59	83	31	104	18
Sebastes flavidus								
Citharichthys stigmaeus		13	24	27	15	33	32	23
Isopsetta isolepis	66	281	90	250	24	90	28	287
Parophrys vetulus	14	9	17	16	4	13	21	18
Stellerina xyosterna	11	29	5	12	3	11	3	17
Ophiodon elongatus								
Liparis pulchellus	3	17	6	5	2	14		2
Pleuronichthys decurrens								
Artedius sp.								
Platichthys stellatus	1							
Sebastes entomelas								
Sebastes paucispinis								
Leptocottus armatus	1	8	4	5	3	7	3	7
Engraulis mordax	187		287		29		60	
Citharichthys sordidus	69	111	16	78	46	171	22	153
Occella verrucosa	5	33		29		3		19
Allosmerus elongatus	1	2	1	2				2
Cymatogaster aggregata	1	3	1	9		5	1	6
Hyperprosopon anale			1	1			12	3

TABLE 21 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Paralichthys californicus					1			
Syngnathus sp.		1	1	2			1	2
Clupea harengus pallasi								
Psettichthys melanostictus	7	5	2	8	1	1		6
Sebastes sp.	33	30	21	29	15	31	10	3
Pholis ornata			1					
Icichthys lockingtoni								
Cottidae (unidentified)			3					
Cnidaria								
Chrysaora melanaster	2							9
Annelida								
Polychaeta (unidentified)								
Arthropoda								
Crustacea								
Isopoda								
Lironeca vulgaris	2	5						5
Decapoda								
Caridea								
Pandalus danae	1	86		69	36	5		1
Crangon franciscorum	289	461	253	218	241	32	151	338
Crangon alaskensis elongata	158	651	85	1,159	131	540	236	609
Crangon nigromaculata								2
Brachyura								
Cancer magister	169	436	862	211	566	71	121	651
Cancer gracilis	1							1
Anomura								
Pagurus beringanus	1	2	2	2		1	2	6

TABLE 21 (CONT.)

Taxon	Station 1 Day	Station 1 Night	Station 2 Day	Station 2 Night	Station 3 Day	Station 3 Night	Station 4 Day	Station 4 Night
Mollusca								
Cephalopoda								
Octopus sp.		6	1		1	3		1
Loligo opalescens	3				2			
Gastropoda								
Nassarius perpinguis								
Echinodermata								
Asteroidea								
Pisaster brevispinus					2	1		
Pycnopodia helianthoides				2	2	3		
Dermasterias imbricata								
Luidia foliolata					1			
Holothuridea								
Eupentacta quinquesemita				1				

APPENDIX E
PART 2

OCEAN DISPOSAL SITE DESIGNATION

NEED FOR AND OBJECTIVES OF ACTION

Study Authority. The ocean disposal site surveys were conducted as part of the evaluation of alternatives for the Crescent City Harbor Project (see main report). These surveys were conducted in accordance with the criteria specified in the Ocean Dumping Regulations (40 CFR 228).

Need for the Action. The proposed action is the final designation of the interim-designated ocean disposal site located for the dumping of dredged materials from Crescent City Harbor which meet the criteria specified in 40 CFR 227.13 (b) (1)-(3). Sediments from Crescent City Inner Harbor would be dredged to facilitate and reduce delays in receipt of petroleum products. Land and beach sites were evaluated in the Main Report for environmental acceptability and economic feasibility. The dredged sediments consist primarily of silt, clay and organic material. They would be incompatible with beach sand, and would be unacceptable for beach disposal according to the criteria specified in 40 CFR 227.13 of the Ocean Dumping Regulations. The land site which was originally considered for dredged material disposal in the final EIS on the Crescent City Harbor Project (filed with CEQ in March 1972), does not have sufficient capacity to contain all of the dredged materials. Most of this area is now occupied by a 308 berth small boat basin and trailer park. The remaining land is used by the Harbor District for disposal of about 10,000 cy annually. The Draft Port Land Use Plan, Technical Report (Spring 1980), also calls for the development of this land area with a marina and its related facilites and services.

Public Concerns Conservation and protection of the ocean environment as a habitat for fish, wildlife, and marine mammals was identified as a public concern at the scoping meeting and in letters from the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. These concerns have also been expressed in several Acts, including the Endangered Species Act of 1973, the Marine Mannal Protection Act of 1972, and the Marine Protection, Research and Sanctuaries Act of 1972.

Concern has been expressed for the protection of commercial and recreational fishing opportunities which the Crescent City area provides.

Objectives of the Action. The objectives of this action are as follows:

(1) To finally designate an ocean disposal site which can be effectively managed to prevent unreasonable degradation of the marine environment from dredged materials being dumped in the ocean.

(2) To finally designate an ocean disposal site which best satisfies the criteria specified in Sections 228.5 and 228.6 of the Ocean Dumping Regulations.

ALTERNATIVES

Consideration of alternative ocean disposal sites was limited to those sites in the Crescent City Harbor area that have been historically used, interim-designated, or considered in the final EIS. Those specific site selection criteria specified in Sections 228.5 and 228.6 of the ocean dumping regulations were considered in the site selection process. These criteria will be evaluated in the Environmental Effects Section.

Alternatives Eliminated from Further Study. The final EIS considered an ocean disposal site in the Battery Point area outside the outer breakwater. This alternative was eliminated from further detailed study as it is primarily a rocky habitat which supports numerous fish species as well as abalone. Kelp beds are also extensive in that area. Dredged material deposited at this site would be transported by currents northward along the shoreline which would adversely impact the rocky intertidal area. This site was opposed by the U.S. Fish and Wildlife Service and the National Marine Fisheries in the final EIS. At a public workshop in Crescent City in 1979, the California Department of Fish and Game also opposed beach fill in that area since the material would wash into the rocky habitat.

No Action. In the absence of any Federal Action taken to finally designate an ocean disposal site for dredged material, the Crescent City Harbor project would not be constructed by the Federal Government. There are no economically feasible land sites available. Long hauling distances would make the project unjustifiable for Federal participation. The local sponsor would be unable to provide construction or maintenance monies. Barge shipments of petroleum products would continue to be inefficient and partial offloading in other ports would be required. Navigation hazards in the entrance channel would remain. The shoaling would continue at a rate of 1 foot/year (22,000 cy per year) and the Harbor District would be unable to dredge more than the 10,000 cy per year they currently dredge with a small pipeline. The pipline is only to work about 15 days per year due to the swells, wave and storm conditions.

Plans Considered in Detail. Three ocean disposal sites were considered in the array of alternatives. They are shown in Figure 1. There is an EPA - interim designated site (herein referred to as site 3) located at 41° 43' 50"N, 124° 12' 10" W in approximately 183 M of water. This site has a 914 m diameter and has not been used historically. It is located at the continental shelf break and has a mud (includes all mixtures at silt and clay) bottom (California Division of Mines and Geology Map Sheet 26, 1975). A second EPA interim - designated site (herein referred to as site 1) is located at 124° 12' 10" W, 41° 43' 15" N in about 27 m of water. It also has a 914 m diameter and has no historical usage. It is located in the inner zone of the continental shelf and was a bottom of fine sand and some pockets of silt. The bottom is irregular with numerous rock pinnacles.

The third site (herein referred to as site 2) is located at'41° 45' 05" N,124° 15' 19"W in approximately 64m of water. In 1977, this site received

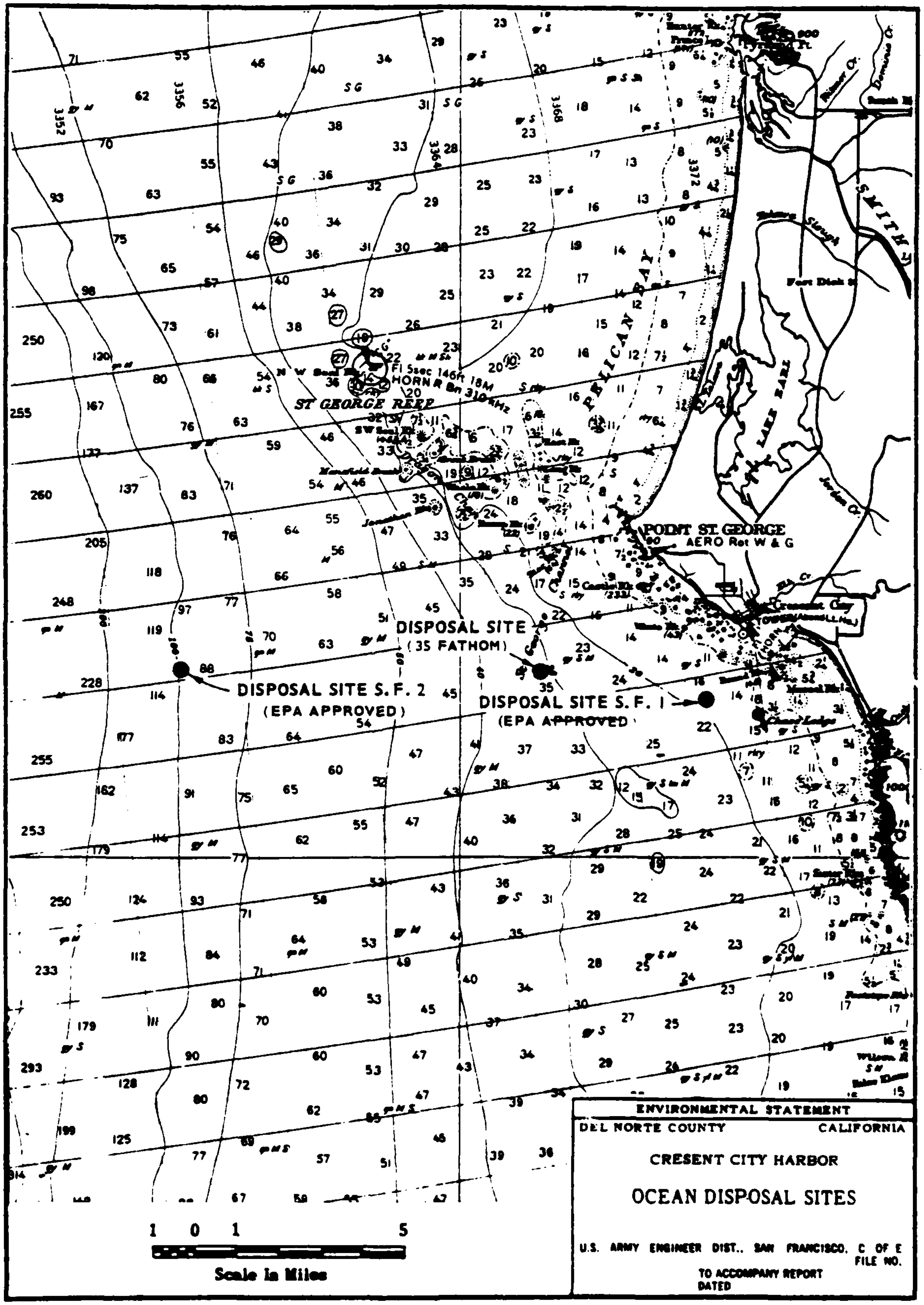

DISPOSAL SITE
(35 FATHOM)
DISPOSAL SITE S.F. 2
(EPA APPROVED)
DISPOSAL SITE S.F. 1
(EPA APPROVED)
ST GEORGE REEF
PELICAN BAY
POINT ST. GEORGE
AERO Rot W & G
SMITH
LAKE EARL
Scale in Miles
ENVIRONMENTAL STATEMENT
DEL NORTE COUNTY
CALIFORNIA
CRESENT CITY HARBOR
OCEAN DISPOSAL SITES
U.S. ARMY ENGINEER DIST., SAN FRANCISCO, C OF E
FILE NO.
TO ACCOMPANY REPORT
DATED

Figure 1

about 144,000 cubic yards of silt, sand, and organics from the Outer Harbor Basin. This site is located in the middle zone of the continental shelf and has a mud bottom.

Mitigation Measures. Several measures were considered for inclusion in all of the plans that would be implemented. These mitigation measures are ways of avoiding or minimizing impacts at the disposal site, rehabilitating or restoring the affected environment, reducing or eliminating long-term impacts by preservation and maintenance operations, or compensating for the impact by replacing or providing substitute resources or environments.

One method of minimizing adverse impacts is to control the means of disposal. The types of equipment that are used for dredged material disposal are limited by the type of material, the distance between the dredge and disposal site, and the type of disposal site available.

For ocean dumping we can consider a hydraulic cutterhead dredge with pipeline disposal, a clamshell dredge with barge dumping, and the trailing suction hopper dredge. The pipeline disposal would be the least desirable from an engineering, environmental, and economic standpoint. A pipeline to the 27m site would require more than 2 miles of pipe and the 64m site would require more than 6 miles. This pipeline would be a hazard to navigation and safety and would interfere with commercial shipping and fishing. This type of dredge is used for example, in small marinas and shallow draft channels, where land areas are available for confined disposal. It would also be a continuous disposal which would cause more environmental damage than a discrete dumping operation. The dredge itself is more disruptive to the dredging area than a mechanical dredge. The hopper dredge is a large sea-going vessel designed to hydraulically lift the sediment from the bottom with drag arms which are pulled through the bottom and collect the sediment in hoppers or bins. The vessel is used for both the dredging and transport of the sediments. It would not be able to dredge the inner harbor area due to the inadequate depths and insufficient maneuvering area. The most feasible alternative is the clamshell and barge operation. The clamshell dredge is used primarily for maintaining depths around wharves and piers. The clamshell dredge is an anchored platform with a swings boom which is used strictly for the dredging phases. It lifts the sediments mechanically rather than hydraulically. A supporting system of tugs and barge provides the collection and transport facility. During disposal, the sediments are released through the bottom of the disposing vessel, about 5m below the surface for barges.

The types and quantities of material to be released are another mitigation measure. The ocean dumping regulations require biological testing of sediments which are not predominantly sand. Therefore, the type of material to be dumped will be evaluated on a project by project basis to determine acceptability for ocean disposal. Both disposal sites are in deep water (27m and 64m) which would allow for sufficient mixing of the low quantities of dredged material taken from Crescent City Harbor.

The U.S. Fish and Wildlife Service has expressed concern for the migration of the endangered gray whale in the fall and winter past Crescent City and for

the winter commercial crab fishery. The disposal of dredged material would be limited to the period from August through November. This would not interfere with the twice-yearly navigation of the gray whale nor would it interfere with the crab migrations or commercial crabbers.

It is also proposed to monitor any ocean disposal site selected for final designation. The monitoring program should include pre-, during, and post-disposal studies which measure physical and chemical parameters of the sediments and water column. It is also recommended that an appropriate sensitive species be selected for long-term monitoring of bioaccumulation potential.

COMPARATIVE IMPACTS OF ALTERNATIVES. The general and specific selection criteria outlined in Sections 228.5 and 228.6 of the Ocean Dumping Regulations were used as the evaluation criteria for comparison of the base and without conditions to the alternative sites. A table of comparative impacts is attached. These impacts are addressed in the Environmental Consequences section on page 8.

AFFECTED ENVIRONMENT

The San Francisco District Corps of Engineers contracted Ecological Analysts, Inc. (EA) to conduct two baseline field surveys of site 1, the interim-designated disposal site to obtain all available information on the proposed disposal site prior to its use. Other data on the use of the two ocean sites was taken from the U.S. Fish and Wildlife Service Coodination Act Report. A literature search was performed which included examination of historical navigation charts to locate submerged historic resources in the form of shipwrecks, etc, at any of the ocean disposal sites. Current navigation charts were used for bottom type, depth profiles, and to identify areas of navigation.

AFFECTED ENVIRONMENT

General Physical Environment. The submerged ocean environments may be divided into several provinces based on the slope and depth of the sea floor. Going seaward from shore, the first province is called the "continental shelf." It is an extension of the continent that is submerged at this point in history. It is generally quite flat, having an average slope of only about 0.1°. The width of the continental shelf off Northern California is relatively narrow and generally steep in comparison with the average shelf characteristic. The area of the continental shelf on a world-wide basis is only about 8 percent of the total area of the oceans.

The shelf ends abruptly at the shelf break where there is a distinct change in slope. Beyond the shelf break is the "continental slope" which slopes downward at an average angle of 4.3° to a depth of 3 or 4 km, typically. The area of the continental slope, on a world-wide basis, is nearly twice that of the continental shelf occupying 15.3 percent of the total area of the oceans (Sverdrup, et al 1942).

At the base of the slope is debris that has been washed down the slope from the continent and deposited at the bottom. This wedge of deposited sediment is called the "continental rise." The continental rise is a smooth apron that rises gently from the true ocean floor or abyss to the base of the continental slope. The abyssal plains are, in general, immense areas of very flat ocean bottom.

There is usually a gradual merging of the continental rise sediments and those of the abyssal plain. More than half of the globe (57%) is covered by water of abyssal depths, that is, over 2000m deep (Bruun, 1957).

The continental shelf has been sub-divided into zones based on the circulation regions and biological provinces. The inner continental shelf is closest to shore and as such is greatly influenced by rivers and estuaries. Therefore, the salinity tends to be the lowest in this zone. The area is shallow and the water temperature closely parallels that of the atmosphere at all seasons. Surface sediments in this zone are primarily sands consisting of detrital quartz and feldspar. Off the Northern California coast this zone extends from the shoreline out to a depth of about 50m. Site 1 is located in this zone.

The middle continental shelf zone is farther from shore and deeper than the inner zone, and is less influenced by runoff. Water temperature tends to parallel that of the atmosphere to a reduced degree, and this zone is subject to some influence from water masses and species from the outer shelf. In Northern California, the surface sediments in this zone consist of patches of mixed sand and mud, modern mud, and exposures of bare rock (Kulm and Fowler 1970). Site 2 is located in this zone.

The outer contiental shelf zone is only slightly influenced by coastal phenomena. Salinities more closely approximate those of the open ocean, and bottom temperatures are nearly uniform the year round. The outer edge of the shelf is marked by the shelf break. This is a zone of transition between the shelf proper and the deep sea. It is influnced both by the hydrography and organisms of the shelf and those of the open ocean. There is a mixing of faunas on a local or seasonal basis. Off the Northern California coast, the surface sediments of the shelf break are composed primarily of modern mud, (fine clays and silts). Site 3 is located in this zone.

Circulation on the Northern California shelf is controlled primarily by large scale weather systems. During the summer, the Northeast Pacific Ocean is dominated by the North Pacific High. Winds are characteristically from the north and northwest. Toward the end of the summer, the North Pacific High weakens and wind patterns are dominated by a low pressure system migrating west to east across the coast. Between July and November, the weak southward flowing California current dominates the nearshore surface current patterns. These nearshore surface currents may also be affected by wind, tides, and the bottom topography. Offshore, the California current is the driving force of the open ocean water throughout the year.

During the winter (November-February), disturbances occur as individual storms of 3 to 7 days in duration. Winds blow primarily from the south and southeast, reinforcing the deep Davidson current. This countercurrent is generally below 200m and moves north bringing warmer more saline water with it.

Because of the relatively narrow continental shelf and strong influence of regionally local wind conditions, the outer continental shelf off the California coast is subject to major upwelling events between February and July. These events may produce associated marked changes in the circulation on and near the continental shelf.

General Biological Environments. The environment of the continental shelf is highly variable on a seasonal and shorter term basis. Proceeding seaward and deeper, the environment tends to exhibit less extreme variation and a greater regularity in the occurence of this variation.

The substratum is strongly related to the distribution and types of species in the benthic shelf communities. The inner shelf zone off Crescent City is composed of fine shifting sands. The benthos must be quite rugged and hardy to withstand the continual pounding by water and other materials moved by waves. They also must be tolerant of a wide range of temperatures, salinities, and dissolved oxygen due to the rapid seasonal changes which occur there. This environment favors the evolution of organisms which are capable of efficient location and ability to withstand burial.

The most abundant benthic organism collected in both the summer and fall surveys at Site 1 was the polychaete, *Owenia collaris*, followed by the gastropod, *Olivella pycna* and the bivalve *Epilucina californica*. *Owenia* are encased and therefore protected by tightly formed, sandy tubes. Both *Olivella* and *Epilucina* are shelled organisms that either burrow or nestle in the sandy substratum. Among the most abundant epibenthic organisms collected at Site 1 were the heavily armored Dungeness crabs, and the *Crangon* shrimp.

Benthic organisms that live in or on mud bottoms are generally mud-eaters and scavengers who do not need heavy armor to protect them from physical elements. Tubeless worms and echinoderms seem to be prevalent in and on this type of substratum.

Macrofauna (benthic and pelagic) of the outer continental shelf off California is incredibly rich with higher biomass values for natural aquatic communities than is usually found at these depths. This is probably related to upwelling resulting in high productivity generally throughout the water column.

Five species of Pacific Salmon occupy the pelagic environment and make great oceanic migrations from the outer continental shelf to the coastal rivers near Crescent City. The Pacific herring (*C. herengus*) overwinter on the outer continental shelf and migrate into nearshore waters in early spring for spawning. Several demersal species of commercially important fish and shellfish, including dover, petrale, rex and English Sole, ocean perch,

Pacific cod, habibut, pink shrimp, tanner crab, and deepwater prawns, are abundant on the outer continental shelf and slope. Fertile dungeness crabs migrate into Crescent City Harbor during September and October. Peak hatching of the young occurs in January. The juveniles use the harbor as a nursery area for about one year and begin moving out in August. They develop offshore, usually at depths greater than 55m.

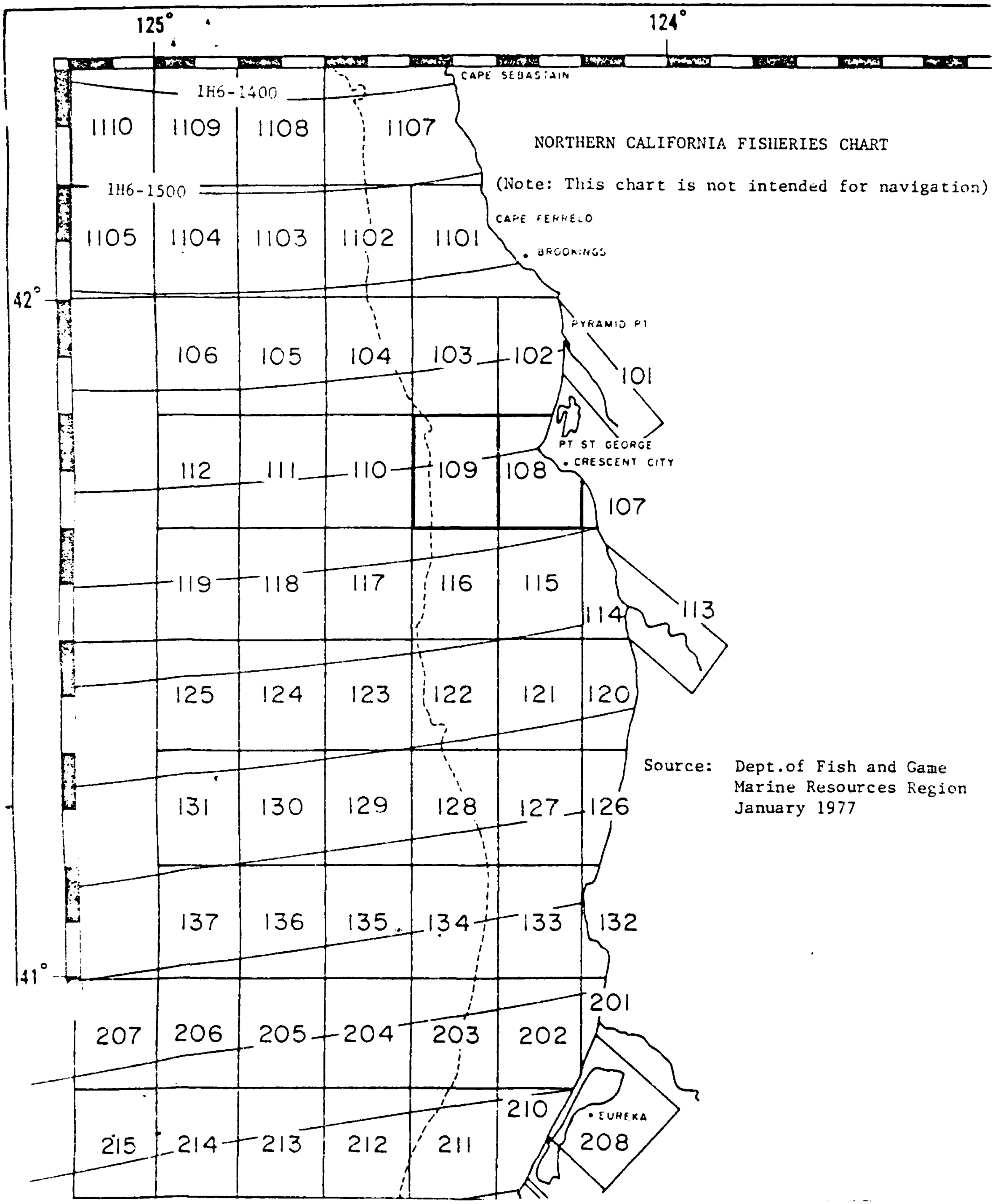
Entire populations of several species of whales migrate past Crescent City twice annually far offshore. Only the endangered gray whale passes close to the coast. Other endangered species that use the ocean include the brown pelican which roosts on offshore rocks and the Aleutian Canada goose. The geese stop near Point St. George in their annual migrations northward.

General Socio- Economic Environment Commerce in the Crescent City Harbor area is presently limited to the receipt of petroleum products and commercial fishing. Since 1971, petroleum products have represented in excess of 90% of the total commerce in Crescent City. The present method of operation requires that barges leaving San Francisco and destined for Crescent City must lighter in either Coos Bay or Eureka. Inadequate harbor depths prevent barges from entering Crescent City Harbor fully loaded. Out of a total of 3,526,000 barrels of petroleum products transported annually from San Francisco to service the three ports, about about 53% arrives at Crescent City Harbor annually. Deepening of Crescent City Harbor would provide for more efficient transport of petroleum products. Project benefits for the UT-10 barge and tug combination utilizing a direct load operation into Crescent City would amount to $585,000 on an annual basis.

Commercial fishing accounts for about 5% of the total commerce in Crescent City Harbor. Within the 3-mile limit, commercial fishing is restricted to trolling for salmon and crabbing with traps. The average salmon catch for the 1974-75 season was 90,870 pounds within the 100 square mile fish block 108 (see Figure 2) outside Crescent City Harbor. The average value of this catch was $45,516. Crabs taken in this same fish block averaged 5,287 pounds with a value of $3,549. The average commercial catch of these species in fish block 109 (10-20 miles offshore; see Figure 2) was about 50% of the catch for the period 1971-1975 in fish block 108. Shrimp taken in fish block 109 averaged 383,494 pounds with a value of $102,476 for the period 1971-1975. This poundage amounts to less than 10% of the total state catch.

Other species taken commercially in fish block 108 outside the 3-mile limit averaged 49,266 pounds with a value of only $6,917. In fish block 109 poundage totaled 1,082,157 for a value of $132,989. The primary species fished for in the "other" category are flatfish.

Most sportfishing in the Crescent City area occurs during June and July close to shore. The most prized catch is salmon which amounts to an average of 482 angler days per year for the period 1971-1978. The estimated dollar value for this catch $5,650. Bottom fishing in the nearshore environment amounted to approximately 38 angler days per year with a value of $115



NORTHERN CALIFORNIA FISHERIES CHART

(Note: This chart is not intended for navigation)

Source: Dept.of Fish and Game
Marine Resources Region
January 1977

FIGURE 2

Small numbers of razor clams are taken from the beach-south of the sand barrier to supply local markets and restaurants. Harvest volumes are insignificant compared with the recreational clam take.

The beach areas delineated ir Figure 3 constitute the most popular clamming grounds in the harbor. The major species sought include gapers, basket cockles and littleneck clams. This fishery is limited to about 8 or 9 part-time diggers (CDFG 1979).

There are no known cultural resources or properties listed in or pending nomination to the National Register anywhere on the offshore Crescent City Area.

There are no plans for any offshore oil and gas leases or marine sanctuaries in or near the Crescent City area.

ENVIRONMENTAL CONSEQUENCES

The effects of the ocean disposal of dredged materials from Crescent City Harbor at each of the alternative sites are summarized in the attached table. This subsection provides a more detailed description of the impacts in the Table and details the differences and extent to which these effects vary among the alternative sites.

Physical Environment.

No action. There will be no significant change in the physical ocean environment off Crescent City during the period 1982-2032.

Site 1. Short-term temporary increases in suspended solids and decreases in dissolved oxygen would occur at this site during the construction and maintenance periods. Dredge material disposal would not significantly change circulation patterns or salinities. Some mounding of sand would occur at this site. The silts and clays would be dispersed to the south. The sand would be redistributed during the first winter storms.

Site 2. Water quality impacts would be smaller at this site due to the greater water volumes avalable for mixing and dilution. However, bottom topography may change due to mounding of sandy materials. These sediments would be more stable and less influenced by weather conditions than those deposited at Site 1. The silts and clays are expected to be dispersed southward upon disposal.

Site 3. Concentrations of dissolved oxygen are not expected to change due to the volumes of water available for mixing and dilution. Sandy dredged materials would probably wash down the slope to the continental rise. Most of the dredged materials would be dispersed by ocean currents and/or mixed by upwelling events.

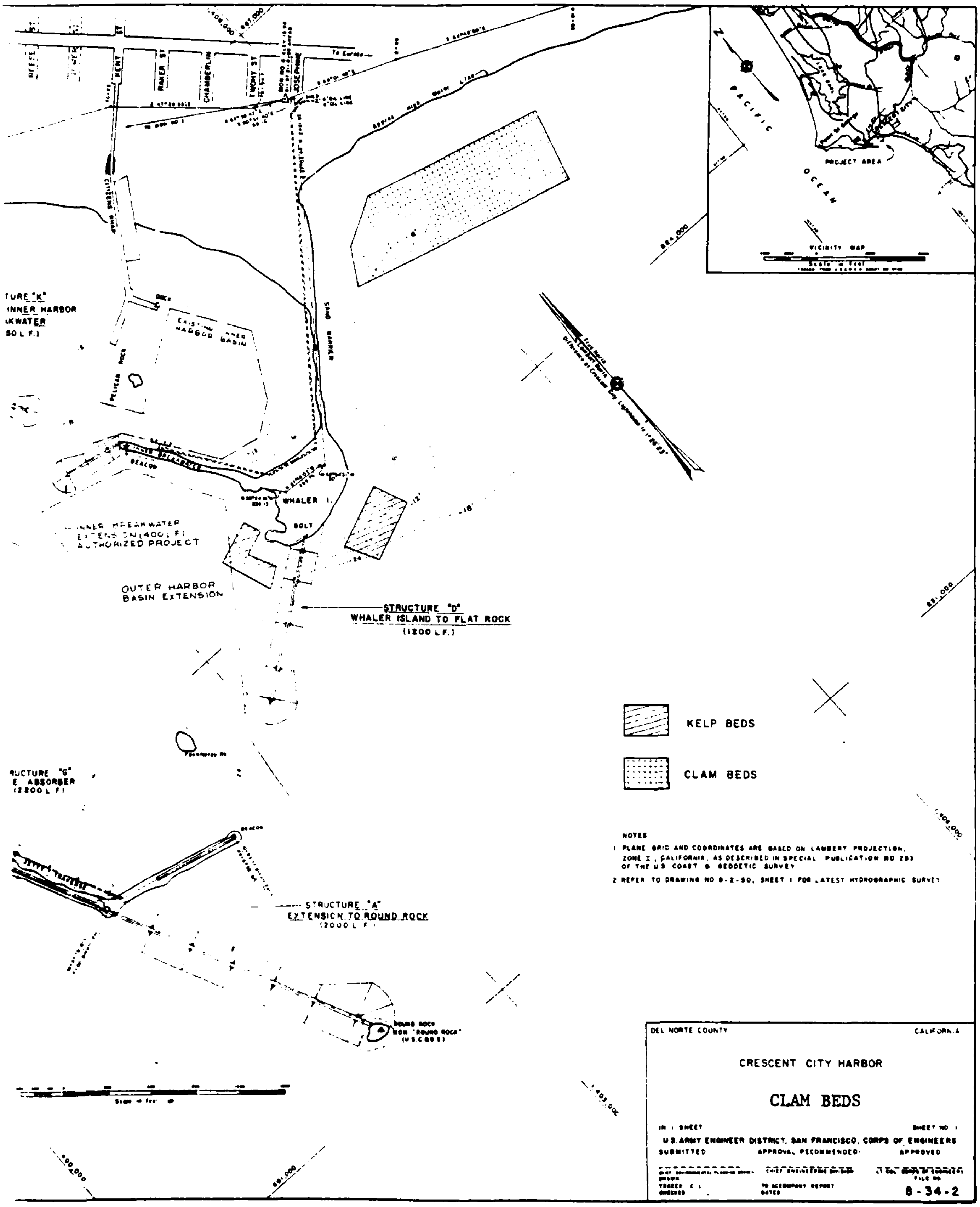

KELP BEDS
CLAM BEDS
NOTES
1 PLANE GRID AND COORDINATES ARE BASED ON LAMBERT PROJECTION, ZONE I, CALIFORNIA, AS DESCRIBED IN SPECIAL PUBLICATION NO 253 OF THE U S COAST & GEODETIC SURVEY
2 REFER TO DRAWING NO 8-2-50, SHEET 1 FOR LATEST HYDROGRAPHIC SURVEY
STRUCTURE "D" WHALER ISLAND TO FLAT ROCK (1200 L.F.)
STRUCTURE "A" EXTENSION TO ROUND ROCK (2000 L.F.)
OUTER HARBOR BASIN EXTENSION
INNER BREAKWATER EXTENSION (400 L.F.) AUTHORIZED PROJECT
EXISTING INNER HARBOR BASIN
WHALER I.
SAND BARRIER
PELICAN ROCK
PROJECT AREA
PACIFIC OCEAN
VICINITY MAP
DEL NORTE COUNTY
CALIFORNIA
CRESCENT CITY HARBOR
CLAM BEDS
U.S. ARMY ENGINEER DISTRICT, SAN FRANCISCO, CORPS OF ENGINEERS
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
8-34-2

Figure 3

Biological Environment.

No Action. There would be no change in the Biota at any of the ocean disposal sites.

Site 1. Benthic organisms, are highly mobile or adapted to unstable bottom conditions and would not be significantly impacted by dredged material disposal. Some organisms may feed on the organics in the dredged materials. Pelagic organisms would avoid any adverse conditions. No long-term biological impacts would be associated with disposal at this site.

Site 2. Benthic organisms at this site would be adversely affected by sand mounding at this site. These organisms are generally soft-bodied, immobile, mud dwellers that would be buried or injured by sand deposition. Pelagic organisms would not be significantly affected by disposal since they are mobile.

Site 3. Sand accumulation would probably occur on the continental rise where organisms are adjusted to debris being deposited. Organisms would probably feed on the organics in the dredged material as they do during times of upwelling.

Socio-Economic Environment

No Action. There would be no significant change in the commercial or sport fishing opportunities in and around Crescent City. Barge shipment of petroleum products would continue to operate inefficiently by a split load method. Lightering would continue at Coos Bay and Eureka.

Site 1. Commercial and sport salmon fishermen would be temporarily disrupted during the 58 day initial construction period and the 10-day biannual maintenance period. No bottom fishermen would be affected since trawling is not permitted within 3 miles of the shoreline.

The costs of using this site are determined by the barge loading time rather than the hauling time. Disposal of approximately 156,000 cubic yards of dredged materials would be about $860,000. Biannual maintenance costs would be $150,000 for 43,000 cubic yards of dredged materials.

Site 2. Both salmon fishermen and bottom fishermen would be temporarily disrupted by disposal at this site. Costs for dredged material would be the same as for Site 1, since they are based on the longer loading than hauling time.

Site 3. Salmon bottom and shrimp fishermen would be temporarily disrupted during the construction and maintenance periods. The commercial salmon catch at this site is about half that of Sites 1 or 2 (based on landing records for fish block 108 and 109). However, the catch of other commercial fish (i.e. flatfish), at this site is more than twice that at sites 1 or 2.

The costs of dredged material disposal at this site are determined by the hauling time since it exceeds the barge loading costs would be $1,020,000. Biannual maintenance of 43,000 cy would cost $285,000.

EVALUATION

This process consists of a comparison of the effects of the use of each ocean disposal site for the receipt of dredged materials from Crescent City Harbor and a consideration of the general and specific site selection criteria specified in Sections 228.5 and 228.6 of the Ocean Dumping Regulations and Criteria. Table 1 is a summary comparison of the alternative ocean disposal sites. The recommended site will be the one that minimizes environmental impacts amd best satisfies the selection criteria.

Site 1 is the recommended alternative based on the evaluation of the selection criteria and the comparison of environmental impacts. This site would have the least effect on the physical and biological environments due to the naturally unstable conditions at the site and the adaptation of the benthic organisms to these conditions. Of the materials that would be disposed of from Crescent City Harbor, only the sands would reach the bottom. The finer materials (silts and clays) would be dispersed. The sandy dredged material would be more compatible with the substrate at Site 1 than with criteria of the other sites that have a mud bottom. Site 1 would be the easiest and the cheapest to monitor due to its close proximity to shore and shallower depth. Site 1 is located near a whistle buoy which would facilitate surveillance and monitoring. Its proximity to shore makes disposal costs at this site less than those for Site 3. Site 2 would be unacceptable from an environmental standpoint due to physical and biological effects of sand disposal.

Table 1

SUMMARY COMPARISON OF ALTERNATIVE OCEAN DISPOSAL SITES

Description	No Action	Site 1	Site 2	Site 3
		ALTERNATIVES		
A. *Site Description*				
1. Location	-	41°43'15"N 124°12'10"W Inner Continental Shelf	41°45'05"N 124°15'19"W middle continental shelf	41°43'50"N 124°12'10"W outer continental sheef
2. Distance from Shore	-	1.3 miles	5.5 miles	12 miles
3. Depth	-	27m	64m	183m
4. Bottom type	-	Fine Sand w/Rock Pinnacles	Mud w/Rock pinnacles	Mud
5. Water Quality	-	Good	Good	Good
6. Historical Usage	-	None	1976-144,000 cy of silty sand	None
7. Distance to South Beach				
8. Prevailing Current	-	Summer: Southward Winter: Northward-Davidson	All year: Southward-California	Southward California current; upwelling in winter
9. Surveillance/ Monitoring	-	Easy-relatively shallow waters close to shore; buoy marker	Moderate	Difficult-more hazardous and costly

Table 1

SUMMARY COMPARISON OF ALTERNATIVE OCEAN DISPOSAL SITES

ALTERNATIVES
(Cont'd)

Description	No Action	Site 1	Site 2	Site 3
10. Marine Sanctuary	-	None planned or in effect	None planned in effect	None planned or in effect
11. Cultural features of historic significance	-	None	None	None
12. Mineral Extraction	-	None	None	None
B. PHYSICAL EFFECTS				
1. Water Quality	NSC[1]	Localized short-term temporary decrease in dissolved oxygen and increase in suspended solids.	Same as Site 1 but of lesser magnitude.	Localized short-term temorary increase in suspended solids of lesser magnitude than Sites 1 or 2
2. Hydrography	NSC	Initial mounding of sand; would be redistributed with first winter storm.	Mounding of sand; probably would not be affected by storms due to greater depth.	NSE[2], sand would wash down slope to continental rise.
C. Biological Effects	NSC	NSE; organisms are mobile and/or adopted to unstable bottom conditions.	Soft-bodied relatively immobile organisms would be buried or injured due to sand deposition.	NSE; organisms on outer shelf are adopted to major upwelling events; organisms on continental rise are adopted to deposition

SUMMARY COMPARISON OF ALTERNATIVE OCEAN DISPOSAL SITES

ALTERNATIVES
(Cont'd)

Description	No Action	Site 1	Site 2	Site 3
D. Socio-Economic Effects				
1. Sport Fishing	NSC	Salmon fisherman would be temporarily disrupted during initial construction and biannual maintenance periods	Same as Site 1	Same as Site 1 but of lesser magnitude
2. Commercial fishing	NSC	Salmon fishing would be temporarily disrupted during initial construction and biannual maintenance periods.	Salmon and bottom fisherman would be temporairly disrupted during initial construction and maintenance periods.	Salmon, bottom, and shrimp fishermen would be temporarily disrupted during initial construction and maintenance periods.
3. Commercial Shippings	Barge shipments would continue to operate inefficiently by split load operations.	Barge shipments would operate efficently using direct shipment to Crescent City average annual benefits with the recommended dredging plan would be $585,000.	Same as Site 1.	Same as Site 1.
4. Dredging/ Disposal Costs	NONE	Dredging 156,000 cy initially and 43,000 cy biannually would would costs $860,000 and $150,000, respectively.	Same as site 1	Dredging 156,000 cy initially and 43,000 cy biannually would cost $1,020,000 and $285,000, respectively.

[1] NSC=No significant change
[2] NSE=NO significant effect

DATE
ILME